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December 1966

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## INTELLIGENCE MEMORANDUM

# The Effectiveness of the Air Campaign Against North Vietnam

1 January — 30 September 1966

## DIRECTORATE OF INTELLIGENCE

NAVY review(s) completed.

ARMY, JCS, OSD and USAF  
review(s) completed.

MORI/CDF Pages 1-230

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FOREWORD

This memorandum presents a detailed analysis of the Rolling Thunder program during the period 1 January-30 September 1966. It follows a preliminary report, The Effectiveness of the Rolling Thunder Program in North Vietnam, [redacted] published in November 1966. The summary in this memorandum is essentially that presented in the earlier paper, except for two major changes, resulting from additional analysis, and some changes in detail. We now find that the costs of the program in 1966 have been much higher, as compared with the dollar value of the destruction achieved, than we had estimated in the preliminary report.\* In addition, our assessment of the interdiction campaign indicates that its reorientation to the high-yield target systems in the northern part of North Vietnam would make Rolling Thunder a more effective program both in terms of maximizing the costs to the enemy and of reducing his capability to recuperate.

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The present memorandum presents comprehensive analyses of some subjects not covered in the preliminary report. Among these are:

- (1) Third country attitudes toward the Rolling Thunder program;
- (2) A study of the consequences of mining the port of Haiphong;
- (3) A detailed re-assessment of the interdiction aspects of the bombing programs in North Vietnam and Laos, including an estimate of the potential of a revised interdiction program; and

\* US and allied costs include only direct operating costs -- aircraft losses and sortie overhead and ordnance costs. The damage to North Vietnamese installations is valued by estimating the cost to North Vietnam of restoring attacked installations; these costs are then converted to dollars. The ratio of the two is a statistical measure of the direct cost of inflicting a dollar's worth of damage in North Vietnam through Rolling Thunder attacks. It should not be interpreted as a monetary expression of the total effectiveness of Rolling Thunder.

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(4) A preliminary examination of North Vietnamese industry to determine the extent to which its evolution toward a war-supporting industry may influence future targeting programs.

These and other analyses are summarized in the body of the memorandum and are supported and documented in seven appendixes not previously provided. We have not reproduced from the preliminary report the analysis of the manpower situation in North Vietnam, the civil defense program in North Vietnam, and some of the details on North Vietnamese political reactions to the Rolling Thunder program. In all other respects, this memorandum supersedes the November report.

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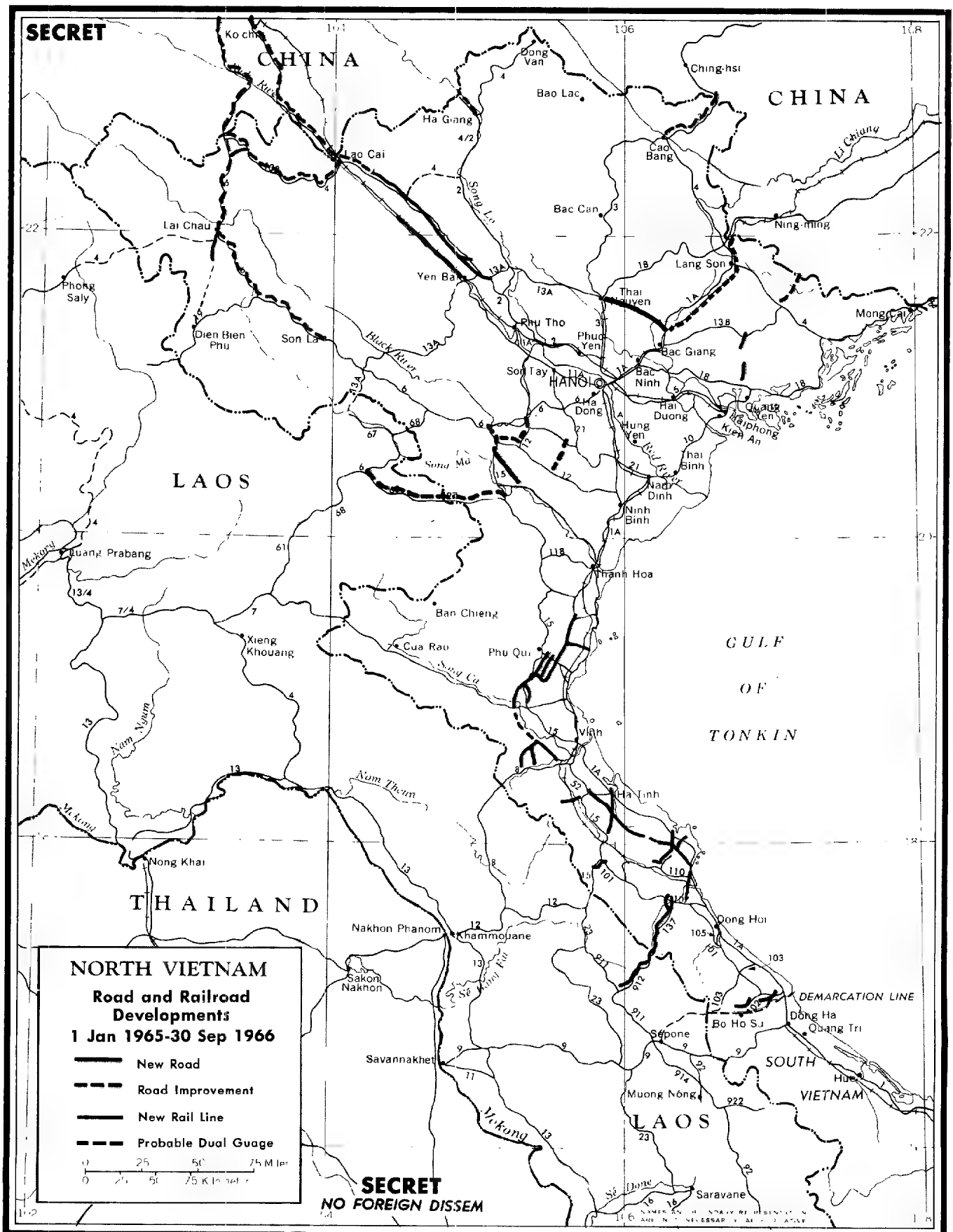
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THE EFFECTIVENESS OF THE AIR CAMPAIGN  
AGAINST NORTH VIETNAM\*  
1 JANUARY-30 SEPTEMBER 1966

Summary

The Rolling Thunder air offensive against North Vietnam has been accelerated sharply in 1966, compared with operations in 1965. The 59,500 attack sorties flown in the first nine months of 1966 against targets in North Vietnam were about 2.3 times the 1965 effort; the 92,000 tons of ordnance dropped was 2.7 times the ordnance delivered on targets in 1965. The 1966 air operations have also been carried out more efficiently than the 1965 campaign. The average bomb load per attack sortie has increased, and the rate of aircraft losses per 1,000 aircraft sorties has been only about 64 percent of the 1965 rate.

By the end of 1965 a growing scarcity of fruitful fixed targets outside of sanctuary areas, as well as other operational restrictions, virtually forced a continually increasing emphasis on armed reconnaissance. This trend was temporarily interrupted by the strikes against major petroleum storage installations, which began late in June 1966. Sorties against JCS fixed-target systems dropped from more than 25 percent of the total sorties flown in 1965 to less than 2 percent in 1966. Armed reconnaissance sorties increased by almost 140 percent, from 55,150 sorties in 1965 to more than 105,600 in 1966. Over 70 percent of total sorties were directed at the southernmost areas of North Vietnam, the Panhandle section south of Thanh Hoa. This shift in the types of targets under attack in large part accounts for an increase of some 40 percent in the cost of inflicting a dollar's worth of damage in North Vietnam -- from an estimated \$6.70 in 1965 to about \$9.50 in 1966.

\* This memorandum was produced by CIA. Aside from the normal substantive exchange with other agencies at the working level, this memorandum has not been coordinated outside CIA. It was prepared by the Office of Research and Reports with a contribution from the Office of Current Intelligence. It was coordinated with the Office of Current Intelligence and the Special Assistant for Vietnamese Affairs; the estimates and conclusions represent the best judgment of this Office as of 7 December 1966.

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The air campaign over Laos shows similar emphasis on the attempted interdiction of the infiltration network into South Vietnam. Attack sorties flown under the Barrel Roll and Steel Tiger programs increased from 11,000 sorties in 1965 to about 38,000 during the first nine months of 1966. Ninety-five percent of the attack sorties flown in Laos in 1966 were on armed reconnaissance missions.

The major measurable effects on North Vietnam of Rolling Thunder attacks are:

(1) About 20 percent, or 70,000, of the total military forces are engaged directly in defensive programs and countermeasures against the Rolling Thunder program. About 220,000 full-time and 100,000 part-time workers have been diverted to repair, reconstruction, and dispersal programs in North Vietnam and Laos. In 1965 and 1966, from 25,000 to 30,000 persons are tentatively estimated to have been casualties of air attacks in the North.

(2) Physical damage to economic and military targets has also increased. This damage amounted to \$69 million in 1965 and an additional \$100 million in the first nine months of 1966. Of the latter total, more than 70 percent represented damage to economic targets.

Despite the increased weight of air attack, North Vietnam continues to increase its support to the insurgency in South Vietnam. The Rolling Thunder program has not been able to prevent about a three-fold increase in the level of personnel infiltration in 1966. The external logistic support needed to maintain the expanded Viet Cong/ North Vietnamese force in South Vietnam has been adequate. In particular, despite the neutralization of the major petroleum storage facilities in the North, petroleum supplies have continued to be imported in needed amounts.

The interdiction campaign against the logistics target system has created burdens and added to the cost of supporting the Communist forces in South Vietnam, but these strains have been within acceptable limits. If the interdiction campaign is to maximize the costs to the enemy and reduce his capability to recuperate, it must

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be reoriented to concentrate on the high-yield transport and logistics target systems in the northern part of the country.

Taking a broader view, during the course of the Rolling Thunder program the North Vietnamese capability to support the war effort has improved.

(1) The capacity of the transportation system, at least as it affects the ability to handle the flow of men and military supplies to South Vietnam, has been increased.

(2) The sizable manpower drain has peaked, unless there is a sharp increase in estimated VC/NVA manpower losses in South Vietnam or a radical change in the nature of the air campaign against North Vietnam. In 1965 and 1966, North Vietnam had to mobilize 80 percent of its physically fit males as they reached draft age. Subject to the assumptions just delineated, this levy could be as low as 50 percent of the 1967 class.

(3) Aid from the USSR and Communist China received in 1965 and 1966 has amounted, in estimated value, to about five times the total damage caused by Rolling Thunder attacks.

The fact that a large share of the imports now flowing into North Vietnam is not military aid but machinery and equipment seems particularly significant. On the one hand, it reflects a willingness of the major Communist powers to provide additional equipment for war-related industrial facilities, probably encouraged by the fact that the modern industrial sector of the North Vietnamese economy has been largely off limits to air attack. On the other hand, it suggests that adequate reserves of skilled manpower, electric generating capacity, and other essential inputs are available on a significant scale for conversion to a war-supporting role. While this new emphasis accelerates the ability to support military operations in the short run, it does postpone Hanoi's long-run plans for the development of heavy industry.

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Rolling Thunder has not visibly reduced the determination of Hanoi to continue the war and there is no evidence that the air attack alone has shaken the confidence of the regime. With increased Soviet and Chinese aid to bolster its capabilities, North Vietnam in the short term at least will not be influenced by the air attack to take positive steps toward a negotiated settlement. In any event, it is estimated that Hanoi will continue to be insistent on a cessation of the bombings as a prerequisite for negotiations. Analysis of popular attitudes in North Vietnam indicates a continued firmness in support of the regime's policies. Although the long-term effects of the war may have some wearying effect on the population, there is no evidence that it has yet reached a point sufficient to deter Hanoi's leaders from their present policies.

Finally, the course of the air campaign in 1966 has had no significant effect on the attitudes of third countries. From the resumption of the bombings in January 1966 to the escalation represented by the bombing of the petroleum storage facilities, attitudes in most Free World countries have remained essentially static. Some countries have tended to be more moderate in their opposition to US policy. The unyielding attitude of the North Vietnamese, particularly during the January bombing pause, has had a somewhat sobering impact on some third countries. Indeed, the escalation against POL storage facilities produced a reaction more restrained and less critical than had been anticipated. Among Communist third countries, the USSR and the Eastern European countries would prefer a negotiated settlement because they regard a continuation of the war as potentially dangerous to themselves and in any case as posing an awkward dilemma for them within the Communist world. The Chinese Communists, however, remain adamant in their attitudes toward the war and oppose any steps leading toward a negotiated settlement.

Over and above the measurable effects discussed in the foregoing, the Rolling Thunder program has certain intangible aspects such as enemy morale and determination which are much more difficult to assess. The Rolling Thunder program has been the object of much neutralist criticism and the target of a concerted Communist diplomatic and propaganda campaign. In one sense, this must serve to stiffen Hanoi's back; at the same time, the program has become one way Hanoi probably measures US determination -- although the extent of US commitment on the ground conveys this determination far more persuasively. Moreover, the Rolling Thunder operation carries some threat of further escalation which could more effectively strain

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Hanoi's ability to support the war in the south, and in this way may exert a certain worrisome pressure on Hanoi. On the other hand, if Rolling Thunder were to be terminated at this point without concessions, the United States would be deprived of one form of leverage against Hanoi which it now has.

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## I. Introduction

The first nine months of 1966 saw impressive increases in the intensity of US/GVN air operations in Southeast Asia.\* In terms of total sorties flown, the US/GVN air effort during January-September 1966 increased by 73 percent, compared with the entire year 1965, and was about evenly divided between targets in South Vietnam and out-of-country targets in Laos and North Vietnam. The greater part of the increase -- some 70 percent -- was accounted for by the air campaigns against Laos and North Vietnam, as shown in the following tabulation:

<u>Area of Operation</u>	<u>Total Sorties Flown</u>		<u>Percent Increase 1966/1965</u>
	<u>1965</u>	<u>January-September 1966</u>	
Laos	16,030	57,060	256
North Vietnam	55,210	105,970	92
South Vietnam	110,310	151,640	37
Total	<u>181,550</u>	<u>314,670</u>	73

The increases in Laos and North Vietnam reflect the growing concern with interdicting lines of communication and infiltration networks.

The air campaign in Southeast Asia has been almost exclusively a US operation. US forces accounted for 92 percent of the total sorties flown and 93 percent of the ordnance dropped in Southeast Asia in the first nine months of 1966.

## II. Rolling Thunder Operations, January-September 1966

### A. Scale of Attack

In terms of total sorties the Rolling Thunder program against targets in North Vietnam increased through September 1966 by 92 percent, compared with all of 1965. Rolling Thunder accounted for 34 percent of total sorties in Southeast Asia in 1966 compared with 30 percent in 1965. Although Rolling Thunder's share of the attack sorties flown

\* See Appendix A.

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in Southeast Asia was only 27 percent in 1966,\* this was also an increase above 1965.

More than 56 percent -- 59,500 -- of the sorties flown in North Vietnam were attack sorties. This compares favorably with 1965 when only 47 percent were attack sorties. As in other areas of Southeast Asia the air campaign against North Vietnam was overwhelmingly a US effort. The South Vietnamese air force has accounted for less than one percent of the total sorties flown over North Vietnam.

Of the total sorties flown against North Vietnam, 44 percent originated from Navy aircraft carriers, 36 percent from US Air Force bases in Thailand, and 20 percent from bases in South Vietnam. Among the US services, the Air Force predominated, accounting for 52 percent of total sorties. This is a reversal of the situation in 1965 when the US Navy dominated the program and accounted for 53 percent of total sorties flown.

The 1966 Rolling Thunder program varied radically from the 1965 campaign in the increasing emphasis on armed reconnaissance rather than attacks on fixed targets. In 1966, only 2,010 sorties were flown against JCS-designated fixed targets, compared with 13,890 sorties in 1965. Armed reconnaissance (excluding restrikes on JCS fixed targets) accounted for over 98 percent of all sorties flown against North Vietnam.

The increasing emphasis on Rolling Thunder as an interdiction program is seen in the geographic distribution of the air effort. More than 70 percent of the total sorties over North Vietnam in the first nine months of 1966 were concentrated in the three southernmost armed reconnaissance Route Package areas (Routes I-III). These three Route Package areas cover the North Vietnamese Panhandle area south from Thanh Hoa to the Demilitarized Zone. On the other hand, only 7 percent of the sorties flown were over Route Package VI, the key northeast area which contains most of the lucrative fixed targets and the two most important rail lines in North Vietnam.

#### B. Ordnance

From January to September 1966, almost 92,000 tons of ordnance were delivered on North Vietnam, nearly 2.7 times the tonnage delivered in 1965. This ordnance amounted to 26 percent of the total ordnance delivered in all air operations in Southeast Asia.

\* Unless otherwise specified, 1966 refers to the first nine months of the year.

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The rate at which ordnance has been delivered on North Vietnam has increased sharply during the year. Whereas the total ordnance delivered in the first three months of 1966 was less than 13,000 tons, over 17,000 tons were delivered in both August and September. The amount delivered in these two months exceeds that delivered in all of 1965. In the past few months the Rolling Thunder program has accounted for about 40 percent of all the ordnance being delivered by all air operations in Southeast Asia.

Ordnance delivered on JCS-designated fixed targets in North Vietnam through September 1966 was only 3 percent of the total, compared to 37 percent in 1965, reflecting the rapidly diminishing share of fixed targets in the total attack on North Vietnam.

#### C. Losses

A total of 249 aircraft were lost during the Rolling Thunder campaign from January through September 1966. These losses amount to 61 percent of total losses in air operations in Southeast Asia during the period. Total losses over North Vietnam include 222 losses resulting from enemy action and 27 from operational losses. The losses sustained in 1966 were at a rate of 4.2 aircraft per 1,000 attack sorties. This is a decided improvement over 1965 when the loss rate was 6.6 aircraft per 1,000 attack sorties.

In addition to aircraft, a total of 339 men were lost during January-September 1966, of whom 131 were later recovered. The recovery rate in 1966 -- 39 percent -- was an improvement over that in 1965 when it was 30 percent. The improvement is particularly notable in view of the fact that many of the losses resulted during attacks on targets located in heavily defended areas.

#### D. Cost of Operations

The US/GVN direct operating costs of the Rolling Thunder campaign (excluding manpower losses) from January through September 1966 were some \$950 million, more than double the direct operating costs in 1965, as shown in the following tabulation:

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	Million US \$	
	1965	January-September 1966
Aircraft lost	305.8	486.8
Operating cost	98.0	233.9
Ordnance	56.2	231.1
Total	<u>460.0</u>	<u>951.8</u>

The cost of air operations over North Vietnam was almost half of the total operating costs of more than \$2 billion for all air operations in Southeast Asia during the nine-month period.

The measurable costs to North Vietnam for the reconstruction or repair of bomb-damaged facilities and other indirect losses attributable to the bombings from January-September was just under \$100 million. Thus the cost of inflicting one dollar's worth of damage during 1966 may be estimated at more than \$9.50, compared with about \$6.70 in 1965. The cost of inflicting damage on North Vietnam in 1966 has increased by about 42 percent. The increase in cost per unit of damage is attributable essentially to the increasing costs of a greatly accelerated air interdiction program concentrated on low-yield target systems.

### III. Effects of the Rolling Thunder Program

#### A. Physical Effects\*

In spite of the significant increase -- 130 percent -- in the number of attack sorties in the air campaign during 1966, the yield, in terms of measurable damage to military and economic target systems, has not increased proportionately. A comparison of the total measurable damage for 1965 and the first nine months of 1966 is shown in the following tabulation:

	Million US \$	
	1965	January-September 1966
Economic targets	35.6	71.7
Military targets	33.5	28.1
Total	<u>69.1</u>	<u>99.8</u>

\* See Appendix B.

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A detailed analysis of the damage inflicted on each major target system is presented in Appendix B. The cumulative damage to economic and military facilities through September 1966 amounted to slightly less than \$170 million. Economic targets accounted for almost two-thirds of the total damage.

A comparison of 1965 and 1966 shows significant variations in the physical effects of the air attack. During 1966 the air campaign became almost exclusively an armed reconnaissance program. Attack sorties flown against JCS fixed targets in 1966 (including restrikes on armed reconnaissance missions) were less than 3 percent of the total number of attack sorties compared with nearly 35 percent in 1965.

From its inception through September 1966, 175 JCS fixed targets had been attacked. A total of 153 JCS targets were struck in 1965 of which 65 were restruck in 1966. During 1966, 87 JCS targets were struck but only 22 targets were being attacked for the first time. The JCS target list of 30 September 1966 includes 242 targets of which 83 targets have not been attacked.\* For the geographic locations of JCS targets and a list of these targets, see Figure 1.

Excluding airfields, over 65 percent of the JCS target program against the military establishment has been implemented. The greatest shortfall has occurred in the implementation of the economic target program. A large number of JCS targets remain among powerplants and other industrial installations, and among critical transportation targets such as locks on the inland waterways, bridges on key rail lines, and the port facilities and mineable areas in the approaches to the principal ports. These unstruck targets would have provided a much greater payoff than many of the JCS targets actually struck during 1965 and 1966, compounding Hanoi's logistic problems and reducing the ease with which it implements effective countermeasures against Rolling Thunder. The airstrikes against JCS fixed targets in 1966 accounted for only 25 percent of total damage, compared with about 70 percent in 1965. The damage yield for each sortie against fixed targets more than tripled, however, rising from \$3,400 per sortie in 1965 to over \$12,000 per sortie in 1966. This rise is explained principally by the concentration of a limited number of attack sorties against high-cost target systems, particularly the petroleum storage and electric power facilities in North Vietnam. Another significant change in the 1966 air

\* The total number of JCS targets struck includes 15 targets struck in 1965 and 1 target struck in 1966 which have been deleted from the current JCS target list.

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campaign is seen in the allocation of damage to military and economic target systems. Damage to military targets in 1966 accounted for less than 30 percent of the total, compared with almost 48 percent in 1965.

Although damage to the North Vietnamese economy is accounting for an increasing share of total bomb damage, the cost has been broadly distributed throughout the economy. The major changes in 1966 have been the sharp increases in estimated damage to transport equipment and petroleum storage facilities, and in indirect losses of exports and agricultural crops. Losses of transport equipment in 1966 were four times their 1965 value; damage to petroleum facilities was three times the 1965 level; and indirect losses of agricultural crops and exports jumped from over \$9 million in 1965 to over \$24 million in 1966.\* In all of these cases the damage sustained has had no significant impact on North Vietnam's ability to continue with the war. Although the attack on petroleum storage facilities eliminated over 76 percent of the targeted national storage capacity, the North Vietnamese had already implemented a system of dispersed storage and have been able to maintain petroleum imports at almost normal levels. Losses of transport equipment have been offset by increased imports. The substantial indirect losses attributed to the bombings have little impact on the course of the war and are more than compensated for by economic assistance from other Communist countries.

The damage sustained by other economic sectors has not yet reached unacceptably high levels. Some 32 percent of total electric power-generating capacity in North Vietnam has been eliminated by air attack. This loss has had only a minor effect on economic activity and on North Vietnam's ability to conduct military operations. The main powerplants in the power system, those most vital to the Hanoi-Haiphong area, have still not been subjected to air attack. The attacks on other economic target systems, including the intensive interdiction program against lines of communication, have yielded relatively low returns. This is essentially because most of these targets are parts of low-value systems or make only a limited contribution to the war. None has been attacked in sufficient depth and concentration. Moreover, the North Vietnamese have acquired increasing skill and flexibility in responding to the disruptions caused by the bombings.

\* It should be noted that losses of agricultural crops are arbitrarily attributed entirely to the indirect effects of the bombing. An unknown part of these losses is in fact due to weather and other natural causes.

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The air attack against military targets has not substantially reduced the capacity of North Vietnam's fixed military establishment. Most of the major military facilities are in sanctuary areas or have not been attacked. The major effort has been against military barracks. All but one of the barracks attacked in 1966 had been struck in 1965 and over half of them appeared to have been deactivated at the end of 1965. In terms of national capacity, no major military target system -- barracks, airfields, SAM sites, naval bases, radar, and supply and ammunition depots -- has suffered as much as 25 percent damage. The attacks have, of course, disrupted normal military practices, caused the abandonment of many facilities, forced Hanoi to engage in wide-spread dispersal of equipment and facilities, and resulted in losses of equipment.

The major change in the 1966 air campaign against military targets has been the increase in losses of equipment, particularly in certain categories such as aircraft and naval craft. Thus almost 20 percent of the MIG-21 inventory and over 40 percent of the in-country MIG-15/17 inventory had been lost as a result of air engagements through September 1966. An additional 50 MIG-15/17s of the DRV are known to be held in China. Losses of naval craft have also been substantial -- one-third of the operational gunboat fleet, one-fourth of the inventory of PT boats, and one-half of the small number (4) of subchasers. Military equipment losses in 1966, including estimated damage to SAM sites, amounted to \$23.5 million, or over 80 percent of the total damage inflicted on military targets.

#### B. Civilian and Military Casualties

The number of casualties which have resulted from the bombing of North Vietnam cannot be estimated with any precision. Analysis of [redacted] and DIA casualty studies does, however, provide sufficient evidence to permit an estimate, which may be subject to a large margin of error.

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Although the United States continues to place restrictions on the air offensive against North Vietnam in order to minimize civilian casualties, North Vietnam still maintains that the Rolling Thunder program is a vicious and unrestrained assault on hospitals, schools, and the general civilian population. The only specific statement from Hanoi in 1965 indicated casualties by September 1965 in the order of 40,000 killed and 35,000 wounded. Analysis at that time could support casualty estimates of only 15 - 20 percent of that number. During 1966, Hanoi has issued only two specific claims on casualties, both

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of which showed relatively insignificant numbers. A letter in May 1966 to the International Red Cross cited only 239 civilian casualties since 31 January 1966, although implying many more. The second statement was an admission by the Education Ministry in October 1966 that only 300 students and 30 teachers had been killed since the bombings began.

Current estimates indicate that despite the great acceleration of Rolling Thunder during 1966, the number of human casualties attributable to air attack has been light. [REDACTED]

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[REDACTED] The estimates for 1965 and 1966 shown in the following tabulation are discussed in greater detail in Appendix B:

	<u>1965</u>	<u>January-September 1966</u>	<u>Total</u>
Civilians	<u>6,000</u>	<u>11,900</u>	<u>17,900</u>
Attacks on fixed targets	2,000	700	2,700
Attacks on armed reconnaissance missions	4,000	11,200	15,200
Military	<u>7,200</u>	<u>3,800</u>	<u>11,000</u>
Attacks on fixed targets	4,300	400	4,700
Attacks on armed reconnaissance missions	2,900	3,400	6,300
Total	<u>13,200</u>	<u>15,700</u>	<u>28,900</u>

The increase in casualties during 1966 is a function of both the growing scale of the Rolling Thunder program and the greater emphasis on armed reconnaissance and targets located in more heavily populated areas. In spite of the increase in casualties, however, the number per sortie has remained stable for both armed reconnaissance and fixed target missions.

The composition of the casualties resulting from the 1966 air campaign differs notably from that in 1965. Over 75 percent of the casualties in 1966 were civilians, compared with 45 percent in 1965. Armed reconnaissance, which accounted for 52 percent of the casualties in 1965, accounted for 93 percent of total casualties in 1966.

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It is estimated that of the total of 15,700 casualties inflicted from January through September 1966, about 40 percent were killed and 60 percent wounded. This would indicate that a total of less than 5,000 civilian deaths have resulted from military action against North Vietnam mostly among persons directly engaged in maintaining and operating the logistic pipeline to South Vietnam. The impact of this loss is not large in a country where over 350,000 persons die annually of other causes and where the number of accidental deaths is at least two to three times the number resulting from the Rolling Thunder program.

### C. Political Reactions

In the previous memorandum, it was estimated that after enduring 18 months of air attack, the North Vietnamese leaders were as determined as ever to continue the war. The regime is apparently united in agreeing that the economic and military sacrifices it has made are not yet an unacceptable burden. Some economic programs have been postponed but support of the war continues to have top priority in Hanoi. Insofar as can be determined, the people of North Vietnam still firmly support the policies of the Hanoi government. The net effect of the bombings seems to have been a reinforcement of this popular support although there are some signs that support for the government is not expressed as actively as when the bombings began. There is no indication, however, that the Rolling Thunder program has resulted in any anti-regime or anti-war sentiments significant enough to generate sufficient political pressure to compel the Hanoi leadership to alter its present attitudes toward the war.

The attitudes of selected third countries toward the bombing of North Vietnam are examined in more detail in this memorandum.\* Popular and official reactions in Free World countries to the bombing of North Vietnam vary widely. The US program receives considerable support, motivated principally by the fear of further Communist aggression if South Vietnam should fall. There is strong opposition to the US program in some of the major neutral nations and allied countries. This opposition reflects generally a fear that the war will escalate into a worldwide conflict or a conviction that the United States is an "aggressor" in the present conflict.

\* See Appendix C.

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During the course of the US air war, third country attitudes throughout most of the Free World have remained essentially static. Some countries have tended to be more moderate in their opposition to US policy. The major reason for this moderating trend has been the frequent indications of US willingness to end the bombings, in contrast to the intransigence of the Hanoi regime. It is estimated that the opposition of third countries to the bombings would not significantly intensify if there were a major escalation of the air war, unless the escalation were accompanied by substantial civilian casualties. Although propagandistic and political opposition might become stronger in the event of further escalation, it seems unlikely that Free World third countries would take retaliatory actions in their bilateral relations with the United States or take measures to provide increased political or material support to the Vietnamese Communists.

Among Communist third countries, attitudes toward the bombing have remained essentially unchanged. The Soviet attitude is in large measure dictated by the need to maintain a certain balance in Soviet relations with the West and with Communist countries, while at the same time supporting a sister Communist country. The USSR reacted to the initial air attacks by attempting to influence Hanoi to begin negotiations. Hanoi's refusal and the Soviet desire to maintain its influence in Hanoi left the USSR with little recourse but to support Hanoi's stand on the war. The USSR has met each escalation of the air war with a reaffirmation of its solidarity with Hanoi and with promises of further economic and military assistance. At the same time, the USSR has been relatively restrained in its condemnations of the United States, unwilling apparently to take any steps which could seriously upset US-Soviet relations or which might lead to a direct military confrontation with the United States. Against a background of a deepening Sino-Soviet rift and a contest for leadership of the Communist world, the Soviet attitude towards the US bombings will remain essentially as it has over the past two years.

The initial Chinese reaction to the US bombings was one of violent and vociferous hostility. The Chinese have provided a steady flow of economic and military aid, including large numbers of support troops. They seem intent on keeping the war going but with definite limitations on the extent of direct Chinese involvement. Chinese rejection of any US exploration of possibilities for a negotiated settlement of the war has been complete and unrelenting. During the past year, however, the domestic turmoil within China has made China more cautious about direct involvement in the Vietnamese war. China's

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propaganda statements in the last six months have been more restrained and reflect a more cautious approach. The Chinese are also now less prone to take steps which could lead to retaliatory measures by the United States.

China's internal crisis and the disarray in its leadership militate against direct intervention in the war at this time. Even an escalated air war with sizable North Vietnamese civilian casualties would not be likely to bring about direct Chinese intervention. Broadly speaking, such intervention is unlikely unless the United States launches a ground invasion of the North or the Hanoi regime seems in danger of collapse. A suspension or reduction of the bombing, on the other hand, would almost certainly have no effect in reducing Chinese insistence that the Vietnamese reject any move toward a negotiated settlement.

#### IV. Assessment of North Vietnam as a Target System

##### A. General Characteristics

North Vietnam has only limited attractiveness as a target system, particularly within the restraints applied to the Rolling Thunder program. The military significance of North Vietnam rests essentially in its three basic contributions to the war in the south: its use as a logistic base for the accumulation and movement of supplies into South Vietnam; its manpower contribution; and its function as a control center for the direction of insurgency. The country is notable because it is waging a protracted war with an inadequate economic base which is not heavily committed to the support of military operations.

The North Vietnamese economy is basically one of subsistence agriculture, with only a small modern industrial sector in a few urban centers, including Hanoi, Haiphong, Nam Dinh, Viet Tri, and Thai Nguyen. The country imports little food and depends largely on domestic production to feed its population of about 18 million persons. More than 80 percent of the population is engaged in agriculture. North Vietnam produces only small amounts of military equipment and must import all of its heavy military equipment and most of its small arms, ammunition, and medical supplies from Communist countries.

The attacks to date on military and economic facilities have not affected significantly the capabilities of North Vietnam's armed forces. Most of the military and economic target systems have not

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been attacked with the depth and concentration of effort required to obtain maximum results. The air campaign has, in fact, become essentially an interdiction program designed to slow down or to make the movement of men and supplies into South Vietnam more costly. Even this campaign has not obtained maximum results, because a substantial part of the most critical lines of communication have not been subjected to intensive interdiction on a sustained basis. A re-orientation of the Rolling Thunder program could produce more meaningful results from the interdiction program and attacks on economic/military target systems. The results to be obtained are, however, limited, not only because North Vietnam's principal contributions to the war do not generally constitute attractive targets, but also because of the military and economic assistance provided by other Communist countries.

B. The Role of External Military and Economic Aid\*

Hanoi's ability to provide continued logistic support to Communist forces in South Vietnam, to withstand the effects of the bombing of North Vietnam, as well as to undertake some economic development activity, is largely dependent on the continued receipt of materiel from Communist China and the USSR.

All countries of the Communist camp responded to the intensified US/GVN air offensive in 1965 by extending military and economic assistance as proof of their support. The major aid programs have been undertaken by the USSR and Communist China. The Eastern European Communist countries have extended only limited amounts of assistance.

Since 1953, North Vietnam has received at least \$1.5 billion in deliveries of economic aid and military equipment from Communist countries. It is estimated that about one-third of the economic aid and over three-fourths of the military aid have been delivered since 1964. During 1965 and in the first nine months of 1966, at least \$350 million in economic aid and \$470 million in military equipment deliveries were provided to North Vietnam. The total deliveries of at least \$820 million amount to almost five times the value of total damage attributable to the Rolling Thunder program. In addition, North Vietnam's trade deficit, which averaged about \$60 million annually in recent years and reached \$100 million in 1965, probably is being written off as grant aid or refinanced under long-term credits.

\* See Appendix D.

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Communist aid is likely to continue to increase in the near future. All Communist countries have pledged substantial amounts of economic and military aid. Imports continue to rise sharply without a compensating increase in exports and there is almost no prospect that North Vietnam will be able to repay the trade indebtedness thus incurred.

The material assistance provided by the USSR and Communist China is a highly significant factor in the North Vietnamese attitude toward continuing the war. The importance of this assistance has been attested to in Vietnamese public statements. The North Vietnamese consider Communist support as valuable in sustaining, if not increasing, the military pressure that can be brought to bear in South Vietnam. They also see it as a protective umbrella which partly inhibits direct allied military pressure on North Vietnam and helps to negate the effects of the bombing. Finally, this aid serves to affirm the ideological unity of the Communist camp in supporting the "war of liberation" in South Vietnam.

Material assistance to North Vietnam is also significant as an apparent commitment of other Communist countries to underwrite the material costs of the war and to assist in the reconstruction of North Vietnam's economy. These assurances undoubtedly underlie North Vietnam's apparent willingness to lose its economic facilities to air attack and to persist in its pursuit of the war in South Vietnam. This attitude is strengthened by the knowledge that even more assistance will be forthcoming.

### C. The Logistics Target System\*

#### 1. The Interdiction Campaign

An assessment of the interdiction campaign against the logistics target system requires an examination of the air campaigns in both North Vietnam and Laos. Over 98 percent -- 104,000 -- of all sorties flown over North Vietnam and the greater part of the sorties flown in Laos -- 57,000 -- were in effect allocated to the interdiction program in the first nine months of 1966. Through the use of aerial photography, it has been possible to confirm the destruction or damage of 359 bridges in North Vietnam and 64 bridges in Laos since the air campaigns started. Pilot reports indicate that probably over 3,000 trucks were destroyed or damaged in North Vietnam in the first nine

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months of 1966 and probably an additional 1,000 trucks were effectively destroyed in Laos.\* In addition, the lines of communication in both countries were subjected to intensive attack on the inland waterways and highways, thus compounding the task of maintaining the supply routes to South Vietnam.

The limited effectiveness of the interdiction campaign is apparent in the short time that the key railroads have been interdicted for through rail service. The Hanoi - Dong Dang line has been interdicted for a total of only two months in 1966 and the Hanoi-Haiphong line has been interdicted for only one month. The Hanoi - Thai Nguyen line has been open to through traffic almost continuously in both 1965 and 1966. On the other hand, two rail lines subjected to more intensive attack (Hanoi - Lao Cai and Hanoi-Vinh) have been interdicted for 5 and 8 months respectively in the first nine months of 1966.

The cost of this interdiction campaign to the Communists has not been excessive. A rough approximation of bomb damage inflicted in Laos during 1966 totals about \$11 million of which some \$5.7 million represents damage to transportation facilities and equipment. In North Vietnam the estimated bomb damage during the first nine months of 1966 is \$24.5 million for transport equipment and slightly under \$10 million for bridges destroyed or damaged. A large part of this latter cost has been avoided through the expedient of using temporary repairs or bypasses rather than attempting permanent repairs.

In spite of these losses, it is estimated that the Hanoi regime has been able to infiltrate men and supplies into South Vietnam at the levels necessary to maintain its forces. Sightings of truck and inland water traffic in North Vietnam throughout 1966 indicate that the level of traffic has not decreased in 1966 and in all probability is at higher levels than it was in 1965. In Laos, for example, the Communists were able during the 1965-66 dry season to construct 400 miles of road in the Panhandle and to make substantial improvements in their

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\* Effective losses in North Vietnam would be less if account was taken of exaggerations in pilot reports and of measures to repair or rebuild damaged trucks. Truck losses in 1965 were at a considerably lower level and more than compensated for by substantial imports. In 1966 a minimum of 4,300 trucks will be imported, so that the net inventory of trucks will be larger at the end of 1966 than it was when the air campaign started.

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all-weather capability to move supplies. During 1966, light truck traffic continued to move into Laos in every month of the rainy season, whereas no truck traffic was reported moving into the Laotian Panhandle during the 1965 rainy season. Although through truck traffic to the South Vietnamese border was not possible during the 1966 rainy season, the North Vietnamese apparently retained a capability of moving some supplies to South Vietnam through a combination of trucking and portage.

## 2. Countermeasures

The success of the Communists in countering the intensive interdiction program is explained by two factors. The first is that although the transport system on which the attack is concentrated is rudimentary, it is also highly diversified and required to carry only small volumes of traffic. It, therefore, offers few lucrative targets for the interdicting force to attack. The second reason is the success the Communists have had in implementing countermeasures.

The Communists have successfully countered the effects of bomb damage to their transportation network and, by improvisations and intensive construction activity, have been able to increase the capacity of the transport system. By December 1966 over 200 miles of bypasses will have been constructed around the heavily interdicted Route 1A in southern North Vietnam. Construction and improvement of the road network since the start of the Rolling Thunder Program has totaled almost 1,200 miles. Over 200 miles of rail construction and improvement has also been completed. The conversion of the rail line from Kep - Dong Dang to dual gauge probably has been completed, and the dual line should be operational by December 1966. During the past dry season the Communist-held road network in the Laos Panhandle has been tripled.

Improvisation techniques are best illustrated by the use of new bridging techniques. Although 359 bridges have been damaged or destroyed in North Vietnam, the North Vietnamese have been able to put in place more than 500 alternate crossings, ranging from culverts and ferries to cable bridges.

Only 183 of the damaged bridges have been permanently repaired at a cost of \$2.5 million, compared with an estimated cost of \$17.3 million if all damaged or destroyed bridges had been permanently repaired.

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In implementing these countermeasures the North Vietnamese have received assistance from Communist China, which has provided an estimated 20,000 railway engineering troops. From 20,000 to 25,000 North Vietnamese and Pathet Lao are engaged in repair and construction activities in Laos.

In addition, the manpower input in 1965 into repair, maintenance, and construction activities in North Vietnam was probably as high as 100,000 men. With the completion of significant additions to the transport network and the experience acquired in bomb damage repair work, it is now estimated that this labor force could be reduced to between 60,000 and 70,000 men.

The efficacy of North Vietnam countermeasures is apparent in some indications of repair activity. Cratered road segments and rail beds are commonly repaired within a 24-hour period. The development of access roads to fords at the site of destroyed bridges has taken less than seven days. These rapid repair techniques coupled with the development of alternate routes provide the North Vietnamese with greater flexibility and more options in the choice of roads to be used to maintain through traffic.

### 3. The Prospects for Interdiction

The historical experience of interdiction campaigns, particularly against a logistics target system such as that in North Vietnam, shows that they can yield only limited returns. Although the present campaign has created burdens and added to the cost of supporting the Communist forces in South Vietnam, these strains have been within acceptable limits.

If interdiction cannot halt the flow of supplies, it at least maximizes the costs to the enemy when it is concentrated on the most vital links in the logistic supply system. In North Vietnam these links are the major port facilities and the initial rail connections from Hanoi to Haiphong, Dong Dang, and Lao Cai. The importance of these transport facilities is that they provide the primary means by which military and essential economic goods are brought into North Vietnam and redistributed internally. They are more lucrative targets than the low-traffic-density highways and waterways in the southern parts of North Vietnam which are extremely difficult to interdict. Over 82 percent of the armed reconnaissance effort in 1966 has been concentrated in the four Route Packages south of Hanoi. And although 80 percent of all the bridges struck to date are south of Hanoi, this concentrated attack has not stopped through traffic from being maintained.

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The transport network and its supporting facilities -- such as rail yards and railroad repair shops -- in the northern part of North Vietnam, on the other hand, services a much higher volume of traffic. As traffic on these connections is increased, an interdiction campaign offers greater opportunities for more meaningful results. Denial of the use of port facilities in North Vietnam and other related measures could increase the traffic burden on the major rail connections to Communist China to the extent that all normal traffic could probably not be satisfied. \* The utilization of surface transport connections at capacity or near-capacity levels would also offer the prospect of more successful armed reconnaissance missions against trucks and watercraft.

Finally, an intensive attack on these vital transport links coupled with 24-hour reconnaissance would create significant problems in repair and recuperability. The success of North Vietnamese countermeasures has been singularly less striking when they have had to cope with destroyed or damaged rail bridges. These are for the most part less adaptable to temporary expedients to keep traffic moving and generally require permanent and more expensive repair work.

#### D. North Vietnam's Industry\*\*

The manufacturing industries of North Vietnam have suffered relatively little damage from airstrikes in 1966. Although attacks against the coal-treatment plant at Cam Pha, the Viet Tri Paper Mill, and the Nam Dinh Textile Plant have had an important impact on coal exports and the production of paper and textiles, the remainder of the manufacturing sector has emerged almost unscathed.

A detailed study of modern industrial installations in North Vietnam shows no appreciable change in the level of production activity at these installations during the period of Rolling Thunder. In only one plant -- the Hanoi Vehicle Repair and Assembly Plant -- has a significant decrease in production activity been noted in recent months. This apparent reduction may reflect the dispersal of a part of this plant's facilities to other areas because the plant plays a significant role in its support of war-related activities. There is no evidence that the Rolling Thunder program has forced any other large-scale industry either to disperse facilities or to curtail production. In fact, the manufacturing capability of North Vietnam has been augmented by a stepped-up rate of imports of machinery and equipment from the Communist countries.

\* See Appendix F.

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There is no evidence that the manufacturing section of North Vietnam has converted to the direct production of military hardware. The manufacturing industries in North Vietnam most capable of providing significant assistance to the military effort are the machine building industry and, to a lesser extent, the chemical industry. The chemical industry manufactures small quantities of tires, pharmaceuticals, and some chemicals used in the production of munitions. A new nitrogen fertilizer plant is already or soon will be in operation. The explosives industry, however, provides only a fraction of the country's current military needs. The machine building industry makes an important contribution to maintenance of the transportation system. The production of spares and the general maintenance of locomotives and construction equipment is the present priority task of North Vietnam's machine building industry.

Imports of machinery and equipment have played an especially important role in the support of the transportation system of North Vietnam and in the improvement of the military communications capability. Along with transportation equipment, the Communist countries have increased deliveries of spare parts, machinery for the repair and maintenance of transport equipment, and construction equipment for the reconstruction and repair of lines of communication. Such imports have supplemented an already existing capability in the North Vietnamese machine building industry for the production of spare parts and simple machinery. The sharp increase in the import of telecommunications equipment almost certainly reflects an effort to upgrade military communications.

The increased program of aid associated with the military effort, however, has not been at the expense of economic aid in general. The number of Communist aid projects has actually increased significantly, and, although some of these projects such as machine building shops clearly have a potential military role, others -- mining, glass, and food products -- are just as clearly non-military in nature.

Neutralization of selected machine building plants in North Vietnam -- the Hanoi Engineering Plant, for example -- would delay recovery from the damage inflicted by the Rolling Thunder program. Destruction of North Vietnam's few major manufacturing facilities outside of the machine building sector and the Haiphong cement plant would be of little value, other than from the standpoint of reducing enemy morale, in the reduction of the North Vietnamese military capability. Even the destruction of the large machine building plants would not be crucial inasmuch as much of the repair capacity is already dispersed. Furthermore, the apparent scope of recent aid agreements

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suggests that the Communist countries will continue to provide North Vietnam both with replacements for essential damaged equipment and with equipment enabling North Vietnam to continue its own repair and maintenance.

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## APPENDIX A

AIR OPERATIONS IN SOUTHEAST ASIA  
1 JANUARY 1965 - 30 SEPTEMBER 1966

I. All Areas of Operation in Southeast Asia

During the first nine months of 1966, US/GVN forces flew nearly 315,000 sorties and delivered about 350,000 tons of ordnance on all areas of operation in Southeast Asia. US aircraft flew 92 percent of the sorties and carried 93 percent of the ordnance.\* About 70 percent of the sorties were attack sorties\*\* and 30 percent were support sorties, approximately the same proportion that prevailed during 1965.\*\*\* The ratio of attack sorties to support sorties did not, however, remain constant for the various individual areas of attack. In North Vietnam, attack sorties rose from 47 percent of total sorties in 1965 to 56 percent in 1966, whereas in South Vietnam attack sorties represented a smaller percentage of total sorties in 1966 than in 1965. The percentages of attack and support sorties in each area are shown in the following tabulation:

<u>Year</u>	<u>North Vietnam</u>		<u>South Vietnam</u>		<u>Laos</u>		<u>All Areas of Operation in Southeast Asia</u>	
	<u>Attack Sorties</u>	<u>Support Sorties</u>	<u>Attack Sorties</u>	<u>Support Sorties</u>	<u>Attack Sorties</u>	<u>Support Sorties</u>	<u>Attack Sorties</u>	<u>Support Sorties</u>
1965	47	53	85 <u>a/</u>	15 <u>a/</u>	68	32	70 <u>a/</u>	30 <u>a/</u>
1966	56	44	77 <u>a/</u>	23 <u>a/</u>	67	33	70	30
1966			80 <u>b/</u>	20 <u>b/</u>				

a. US sorties only. Distribution of sorties by South Vietnamese Air Force in 1965 is not available.

b. All US/GVN sorties.

\* For a summary of sorties and ordnance delivered on all areas of operation in Southeast Asia, by delivering service, see Table A1.

\*\* Including strike and flak suppression sorties, and sorties in close air support of ground operations, plus the major carriers of ordnance.

\*\*\* A monthly distribution of sorties over all areas of operation in Southeast Asia, by mission and nationality, during 1965 and the first nine months of 1966 is presented in Table A2.

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The following tabulation shows that nearly half of the sorties, and somewhat over half of the ordnance delivered, was on South Vietnam with the larger share of the remaining half of the effort being directed against North Vietnam:

Area of Operation	January-September 1966			
	Sorties		Ordnance	
	Number	Percent	Tons	Percent
Laos	57,060	18	59,750	17
North Vietnam	105,970	34	91,770	27
Laos and North Vietnam combined	<u>163,030</u>	<u>52</u>	<u>151,520</u>	<u>44</u>
South Vietnam	<u>151,640</u>	<u>48</u>	<u>195,700</u>	<u>56</u>
Total Southeast Asia	<u>314,670</u>	<u>100</u>	<u>347,220</u>	<u>100</u>

Since mid-1965 the increase in sorties flown over South Vietnam has been approximately parallel to the increase in sorties flown over North Vietnam and Laos combined, and since the beginning of 1966 the increase in sorties flown over North Vietnam\* has been roughly proportional to the decrease in sorties flown over Laos (see Figure A1).

The amount of ordnance delivered monthly by air on Southeast Asia remained fairly constant during 1966. It was a little over 38,000 tons in January, increased to over 44,000 tons by August, and was a little over 39,000 tons in September. Similarly, the amount of ordnance delivered monthly on South Vietnam also remained fairly constant, fluctuating within the range of 18,000 to 26,000 tons. The amount of ordnance delivered monthly on North Vietnam, however, increased substantially, while the ordnance delivered on Laos declined sharply (see Table A5 and Figure A2). The amount of ordnance delivered on North Vietnam in September 1966 was nearly four times

\* For a presentation of sorties flown monthly over South Vietnam and Laos in 1965 and the first nine months of 1966, see Tables A3 and A4. The comparable data pertaining to North Vietnam are presented in Table A9.

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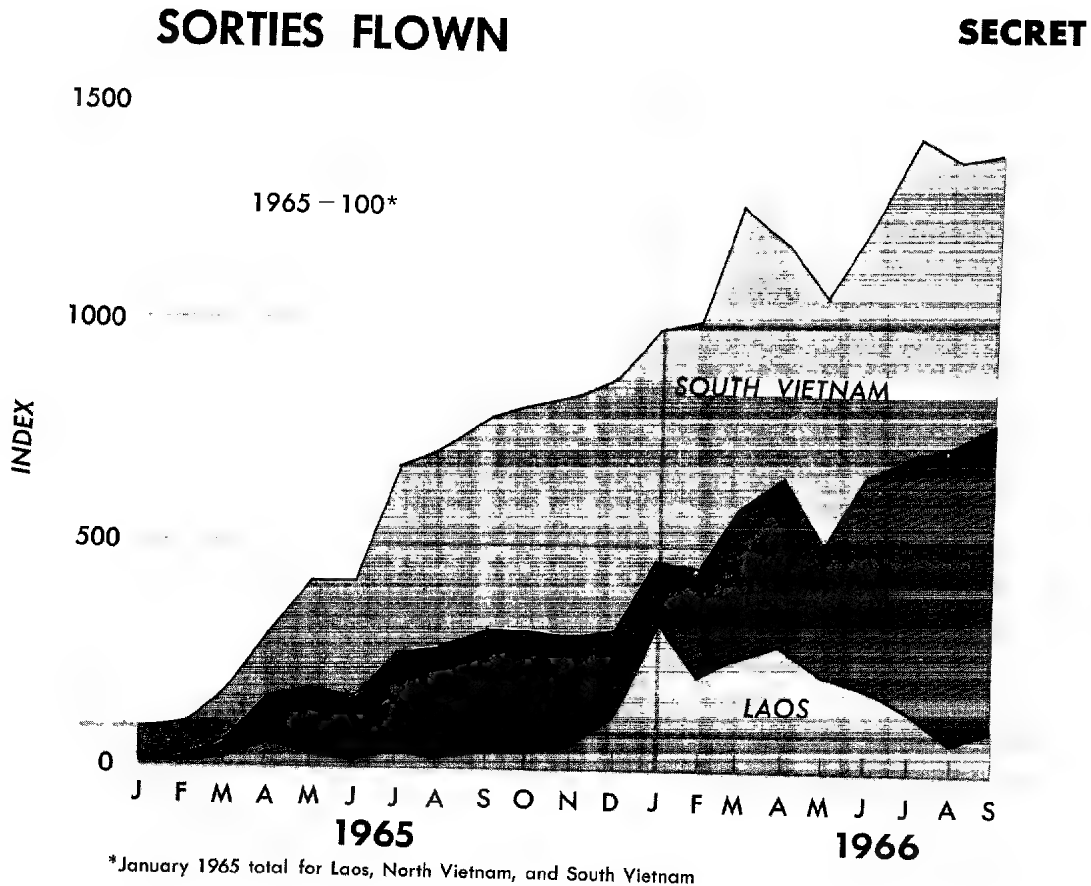


Figure A-1. Index of Sorties Flown in Southeast Asia and Relative Amounts in Each Area, 1965 and January-September 1966

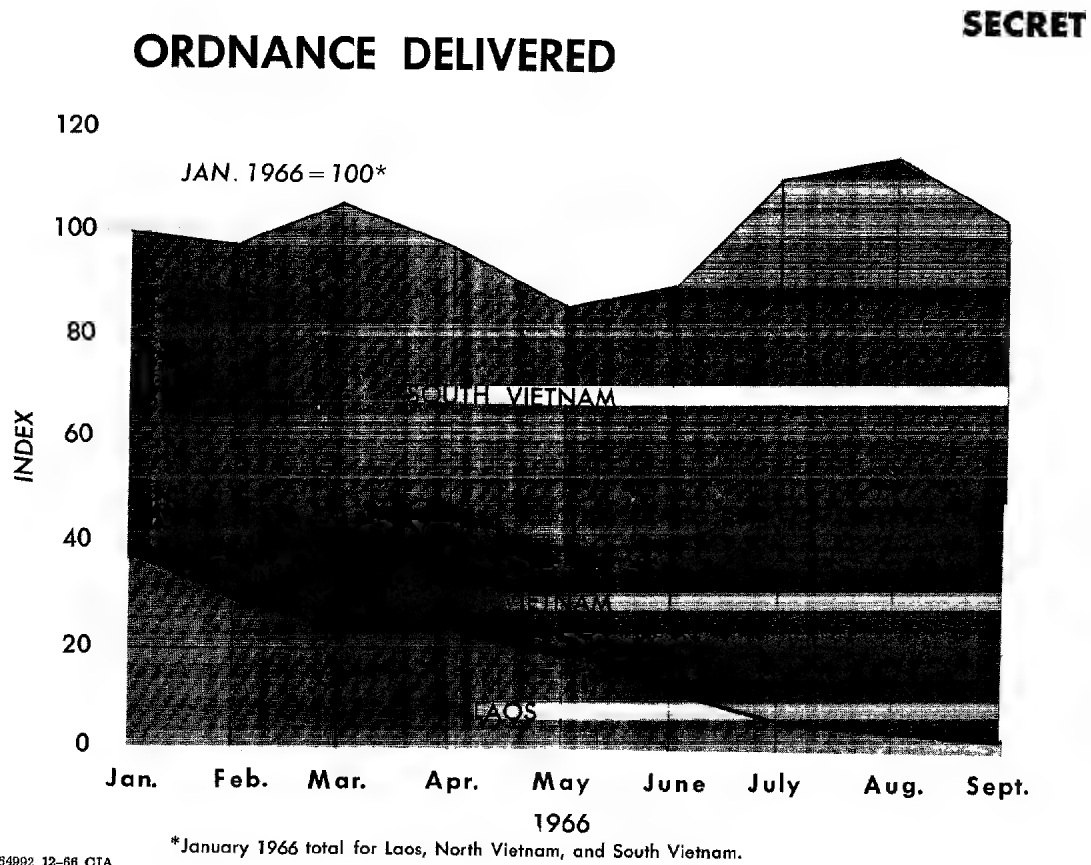


Figure A-2. Index of Ordnance Delivered in Southeast Asia and Relative Amounts in Each Area, January-September 1966

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the amount delivered in February, the first complete month of bombing during the year, and was more than three times the amount delivered in September a year ago, the peak month of 1965. The amount delivered on Laos in September 1966, on the other hand, was less than 9 percent of the amount delivered in January.

The US air effort in Southeast Asia was carried out by aircraft stationed in South Vietnam and Thailand as well as by aircraft from US Navy carriers in the Gulf of Tonkin and in the South China Sea. The US Air Order of Battle in the area as of 26 October 1966 was as follows:

<u>Launch Base</u>	<u>Air Bases</u>	<u>Aircraft</u>				<u>Total a/</u>
		<u>USAF</u>	<u>USN</u>	<u>USMC</u>	<u>USA a/</u>	
South Vietnam	30	723	9	438	1,985	3,155
Thailand	7	422	0	0	0	422
Naval carriers	2 to 3	0	151	41	0	192
Total aircraft		<u>1,145</u>	<u>160</u>	<u>479</u>	<u>1,985</u>	<u>3,769</u>

a. US Army aircraft, mostly helicopters and light observation aircraft, have not been considered in this report.

Approximately 55 percent of all US sorties flown in Southeast Asia originated from bases in South Vietnam, 30 percent from aircraft carriers, and 15 percent from bases in Thailand.\* During the first nine months of 1966, about 70 percent of all US sorties flown from South Vietnam struck targets in South Vietnam, 20 percent were flown over Laos, and 10 percent over North Vietnam. Approximately 65 percent of the sorties from Thailand were flown over North Vietnam and 35 percent over Laos. To avoid violation of Cambodian air space, no sorties were flown from Thailand over South Vietnam. About 55 percent of the sorties from the Navy aircraft carriers during the first nine months of 1966 were flown over North Vietnam, 25 percent over South Vietnam, and 20 percent over Laos.

\* The distribution of sorties from each of these launch bases to the three target areas in Southeast Asia is shown in Table A6.

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More than 405 planes were lost in the air war over Southeast Asia during the first nine months of 1966. \* Of the 405 aircraft, 330, or approximately 81 percent, were reported as combat losses, due to hostile action, and 75, or about 19 percent, were reported as operational losses. Sixty-two percent of total losses were in operations against targets in North Vietnam, 24 percent against targets in South Vietnam, and 14 percent against targets in Laos. The number of planes lost per month, and more significantly, per 1,000 sorties, remained relatively constant for all areas of operation in Southeast Asia. \*\* The average number of combat losses per 1,000 attack sorties during the first nine months of 1966 was 1.5 for all of Southeast Asia, compared with 3.7 for North Vietnam, 0.5 for South Vietnam, and 1.3 for Laos.

The direct operational cost of the air operations in Southeast Asia during the first nine months of 1966 is estimated to be more than \$2 billion -- approximately \$950 million in operations over North Vietnam, \$820 million over South Vietnam, and \$310 million over Laos. These costs include only the production cost of aircraft lost, sortie overhead expenses, which vary directly according to the number of hours flown, and the cost of ordnance expended. They make no allowance for such indirect overhead as the cost of maintaining air bases or keeping aircraft carriers on line, or logistic support. \*\*\* The value of damage done to the economy of North Vietnam by air operations during 1966 has been estimated at about \$100 million. The restoration cost of targets reported as destroyed or damaged by pilots over Laos is estimated to be about \$11 million. It is impossible to estimate the economic cost to the North Vietnamese and Viet Cong of airstrikes within South Vietnam. The cost of inflicting a dollar's worth of damage in North Vietnam was about \$9.50, up about 42 percent from an estimated cost of approximately \$6.70 in 1965. The cost of inflicting a dollar's worth of damage by sorties carried out over Laos in 1966 has been about \$28.80. The disparity between the unit cost to the United States of doing damage in North Vietnam compared with damage in Laos reflects the more capital intensive nature of targets in North Vietnam. The figure for both areas, however,

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\* This figure does not include losses by the US Army.

\*\* Monthly aircraft losses in Southeast Asia are presented by area of operation, nationality, and type of loss in Table A7.

\*\*\* The estimated direct operational costs of air operations in Southeast Asia are summarized in Table A8 and Figure A3.

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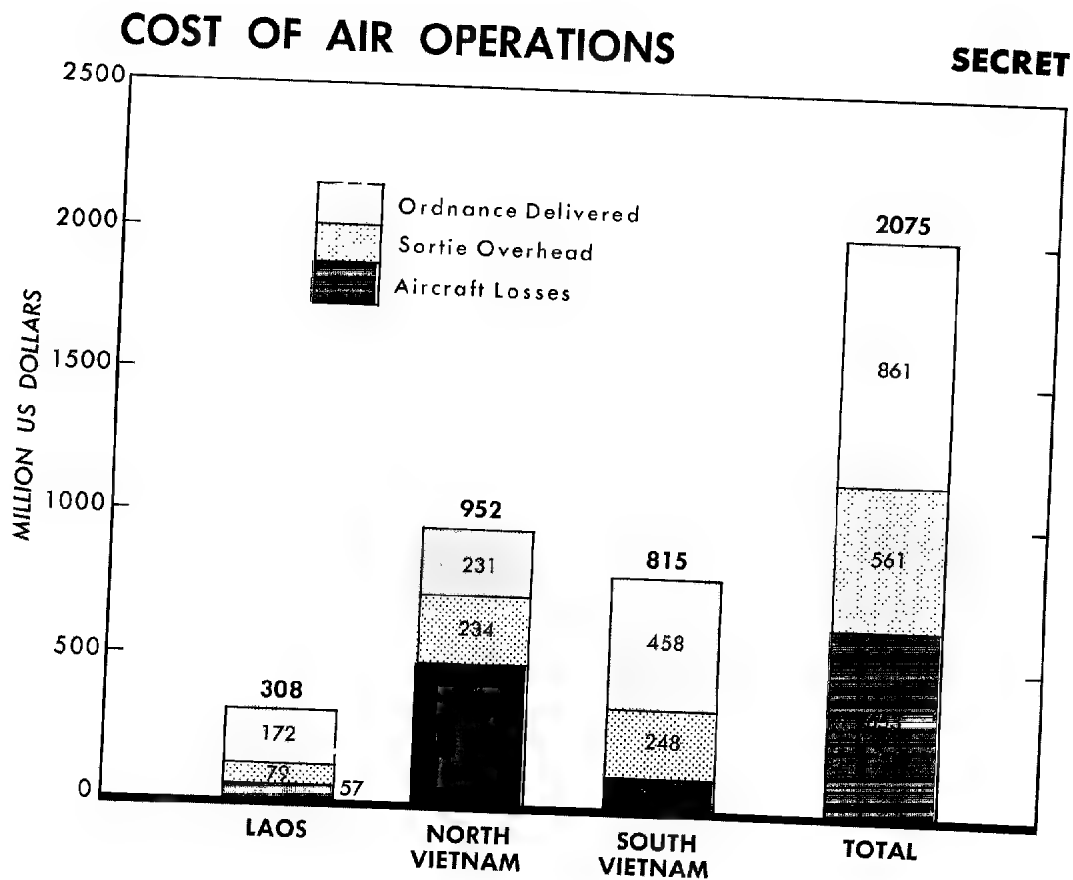


Figure A-3. Estimated Direct Operational Cost of US/GVN Operations in Southeast Asia, January-September 1966



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makes it evident that the relative cost and value of the air war in South-east Asia must be measured in military, political, and psychological terms, rather than economic.

## II. North Vietnam

### A. Sorties

During the first nine months of 1966, a total of 105,970 sorties was flown against North Vietnam, nearly twice the total of 55,210 flown during 1965.\* In 1966, as in 1965, US aircraft flew 99 percent of the sorties, and aircraft of the South Vietnamese Air Force flew the remaining 1 percent. The share of attack sorties in the total increased from 47 percent in 1965 to 56 percent in 1966, while the share of support sorties declined from 53 percent to 44 percent. Thus the number of ordnance-carrying sorties increased, relative to the total.\*\* Sorties flown over North Vietnam in 1966 represented 34 percent of total sorties flown in Southeast Asia, compared with 30 percent in 1965. Sorties flown against fixed targets from the JCS target list, which in 1965 accounted for 25 percent of total sorties, represented only about 2 percent of total sorties in 1966. Armed reconnaissance sorties not carried out as restrikes of JCS fixed targets increased from 75 percent of total sorties in 1965 to 98 percent in 1966. The US Air Force, which flew 44 percent of all sorties against North Vietnam in 1965, increased its share to 52 percent in 1966, while the share of the US Navy declined from 53 percent to 44 percent. The US Marine Corps increased its share from 2 percent in 1965 to 3 percent in 1966, and the share of the South Vietnamese Air Force remained constant at 1 percent.\*\*\*

Of the total sorties against North Vietnam, 44 percent originated from the Navy aircraft carriers, 36 percent from US Air Force bases in Thailand, and 20 percent from bases in South Vietnam (see Table A11). To facilitate the assignment of armed reconnaissance sorties, North Vietnam is divided into six areas known as Route

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\* Data pertaining to the air attack on North Vietnam in 1965 and 1966 are summarized in Figures A4, A5, and A9.

\*\* For a presentation of monthly sorties over North Vietnam in 1965 and 1966, by mission and nationality, see Table A9.

\*\*\* For a presentation of monthly sorties against North Vietnam during 1965 and 1966, by program and by service, see Table A10 and Figure A6.

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Packages (see Figure A7). During the first nine months of 1966, more than 70 percent of the US sorties flown over North Vietnam were concentrated in attacks on transportation and port facilities located in Route Packages I, II, and III, covering the panhandle south of Thanh Hoa (see Table A12). About 39 percent of all US sorties attacked targets in Route Package I, which extends from the 18th Parallel to the DMZ. Approximately 20 percent of all US sorties were flown over Route Packages IV through VI, including 7 percent over Route Package VI in the key northeast area. Most of the more publicized strikes in 1966 were in the area of Route Package VI, including the strikes on bulk petroleum storage facilities at Hanoi and Haiphong, on the Uong Bi thermal powerplant, and on the coal-processing facilities at Cam Pha. The vital Hanoi - Dong Dang and Hanoi - Haiphong rail lines are also in Route Package VI.

#### B. Ordnance

During the first nine months of 1966, sorties flown over North Vietnam delivered a total of 91,770 tons of ordnance, or nearly 2.7 times the tonnage delivered during 1965. The amounts delivered during the early months of the year were much smaller than in the later months. The total for January-March was only about 12,790 tons, whereas 17,760 tons were delivered in September alone -- an amount equal to about 52 percent of the total ordnance delivered on North Vietnam during all of 1965. The US Air Force delivered 59 percent of all ordnance expended on North Vietnam during January-September 1966, the US Navy 37 percent, the US Marine Corps 3 percent, and the South Vietnamese Air Force 1 percent. The shares in total ordnance delivered on North Vietnam in 1966, compared with similar shares for 1965, are shown in the following tabulation:

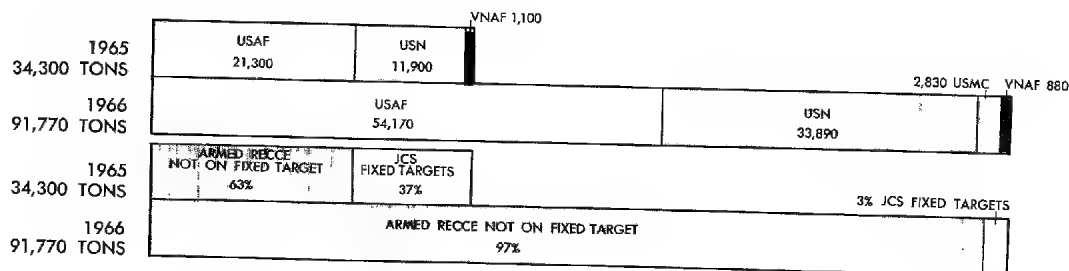
	<u>Percent</u>			
	<u>USAF</u>	<u>USN</u>	<u>USMC</u>	<u>VNAF</u>
1965	62	35	N.A.	3
January-September 1966	59	37	3	1

Ordnance delivered on fixed targets from the JCS target list represented only 3 percent of total ordnance delivered on North Vietnam during the first nine months of 1966, compared with 37 percent during 1965. Conversely, ordnance delivered by armed reconnaissance

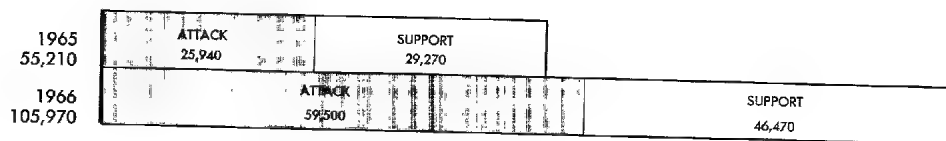
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Figure A-4. Statistical Summary of Ordnance Delivered and Sorties Flown in North Vietnam, 1965 and January-September 1966

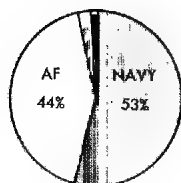
### ORDNANCE DELIVERED



### SORTIES FLOWN

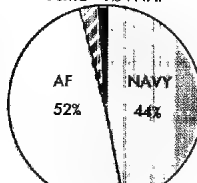


2% USMC 1% VNAF



1965

3% USMC 1% VNAF



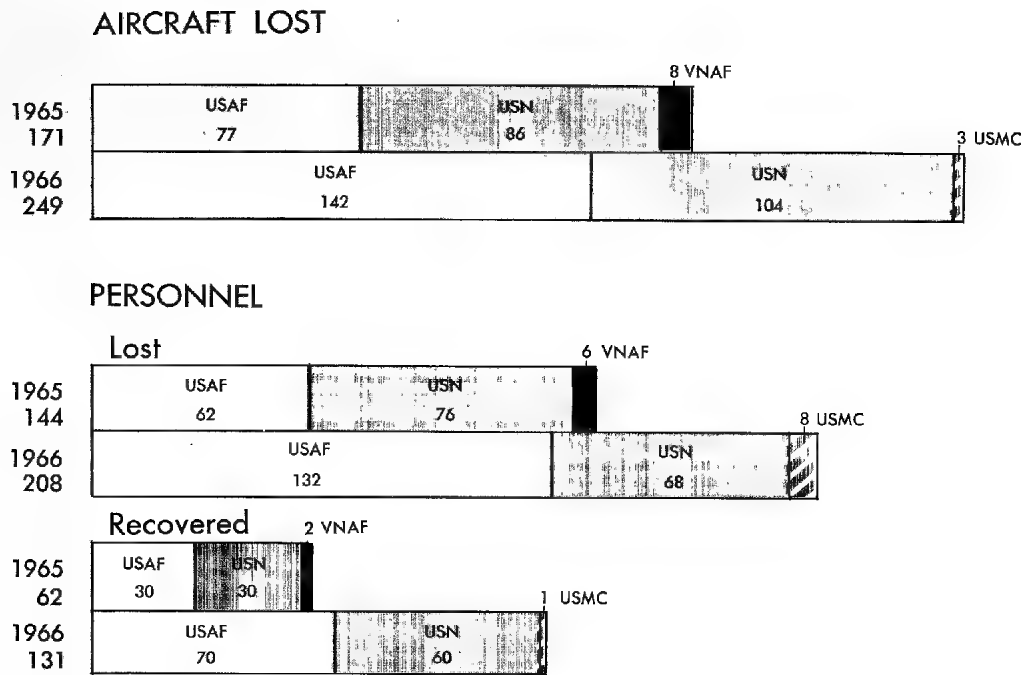
1966

SERVICE	1965	1966
USAF	24,500	54,900
USN	29,100	46,570
USM	890	3,690
SVAF	720	810
	55,210	105,970

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Figure A-5. Statistical Summary of Aircraft Lost and Personnel Lost and Recovered in North Vietnam, 1965 and January-September 1966



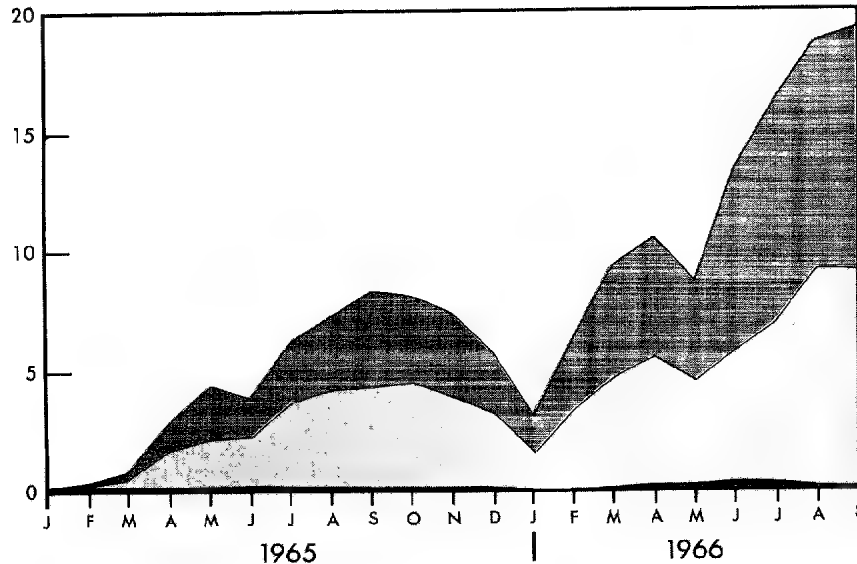
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## SORTIES FLOWN

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THOUSAND SORTIES

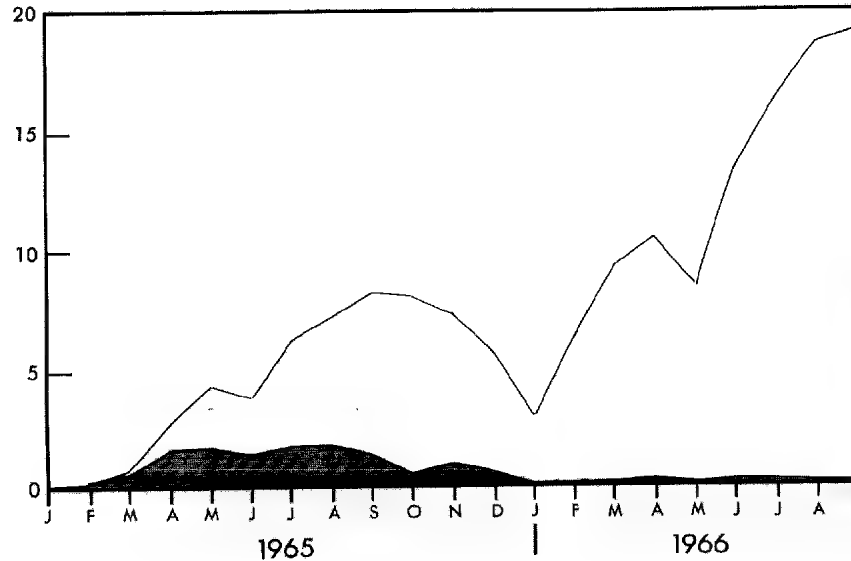
BY SERVICE



	USN & USMC	USAF	TOTAL
J 1965	0	0	0
F	120	160	260
M	410	480	890
A	1,660	1,200	2,970
M	1,940	2,230	4,340
J	2,000	1,840	3,940
J	3,740	2,460	6,200
A	4,180	3,030	7,250
S	4,330	3,910	8,240
O	4,530	3,490	8,020
N	3,970	3,330	7,310
D	3,110	2,680	5,790
J 1966	1,450	1,570	3,020
F	3,330	3,190	6,520
M	4,820	4,600	9,440
A	5,550	4,990	10,540
M	4,550	3,660	8,720
J	5,610	6,610	13,220
J	6,680	9,520	16,440
A	9,160	9,680	18,840
S	9,110	10,110	19,230

THOUSAND SORTIES

BY PROGRAM



	FIXED TARGETS	ARMED RECCE*	TOTAL
J 1965	0	0	0
F	0	260	260
M	850	40	890
A	1,800	1,170	2,970
M	1,790	2,550	4,340
J	4,100	2,530	3,940
J	4,910	4,290	6,200
A	4,900	5,350	7,250
S	1,600	6,640	8,240
O	720	7,250	8,020
N	1,040	6,270	7,310
D	820	4,970	5,790
J 1966	0	3,020	3,020
F	170	6,350	6,520
M	1,180	9,260	9,440
A	390	10,150	10,540
M	160	8,560	8,720
J	1,720	12,900	13,220
J	260	16,080	16,440
A	240	18,560	18,840
S	1,000	19,080	19,230

\* Not on JCS Fixed Targets  
64994 12 86 CIA

Figure A-6. Monthly Summary of Sorties Flown in North Vietnam, by Service and by Program, 1965 and January-September 1966



Figure A-7

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strikes not on JCS fixed targets accounted for 97 percent of total ordnance delivered in 1966, compared with 63 percent in 1965. This change was a continuation of a trend already under way in late 1965, when, in comparison with previous levels, the attack on fixed targets represented a rapidly declining share of the total attack on North Vietnam. The decline undoubtedly reflects the diminishing number of potentially fruitful new fixed targets for which strikes were authorized, broadened authorization for armed reconnaissance, and, at least in part, a change in definitions used in bookkeeping.

The average ordnance load per attack sortie against North Vietnam during the first nine months of 1966 was a little more than 1.5 tons per sortie, a slight increase over the 1.3 tons per sortie averaged in 1965.\*

#### C. Losses

A total of 249 aircraft and 208 men were lost in the air attack on North Vietnam during January-September 1966. An additional 131 men were lost but recovered. Losses by service are compared for 1966 and 1965 in Table A15. In both 1965 and 1966, the service that flew the largest number of sorties lost the largest number of planes. In 1965, this was the US Navy, and in 1966, the US Air Force. Total losses are related to attack sorties in the following tabulation. The average number of aircraft lost per 1,000 attack sorties dropped from about 6.6 in 1965 to a little less than 4.2 in 1966,\*\* as shown in the following tabulation:

<u>Year</u>	<u>Total Attack Sorties</u>	<u>Total Losses</u>	<u>Losses as a Percent of Total Attack Sorties</u>
1965	25,940	171	0.66
1966	59,500	249	0.42

\* For details on ordnance delivered on North Vietnam in 1966, by month, program, and delivering service, see Tables A13 and A14 and Figure A8.

\*\* Calculated on the basis of total losses -- combat and operational. The rate for combat losses only is 3.7 aircraft per 1,000 attack sorties.

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Losses by model of aircraft are compared for 1966 and 1965 in Table A16. Losses as a percent of total sorties flown by models of aircraft most used either remained about the same or increased slightly.

D. Cost Effectiveness of Operations Against North Vietnam in 1966

The direct operational cost of the air attack on North Vietnam during the first nine months of 1966 is estimated at something more than \$950 million, or more than double the cost of the attack during 1965. This figure includes the production cost of the aircraft lost, valued at \$487 million; direct sortie overhead costs, estimated at about \$234 million (not including any allowance for maintenance of air bases and the aircraft carriers or for logistic support); and ordnance costs of \$231 million. The value of the damage inflicted on North Vietnam by the air attack has been estimated at about \$100 million, consisting of \$28 million in military costs, \$47 million in direct economic costs, and \$25 million in indirect economic costs. Thus the cost of inflicting one dollar's worth of damage on North Vietnam during 1966 may be estimated at more than \$9.50. The comparable figure in 1965 was about \$6.70. Details of these cost estimates are presented in Table A17 and in Figure A 9. The cost of the air attack and of the damage to the economy of North Vietnam are compared on a monthly basis in Figure A10. The costs of the US/GVN air operations and the value of damage to the economy of North Vietnam, in general, fluctuate together. On the average, however, the cost of the air operations per unit of damage to the North Vietnamese economy was about 42 percent higher during the first nine months of 1966 than it was during 1965.

E. The Attack on Fixed Target Systems

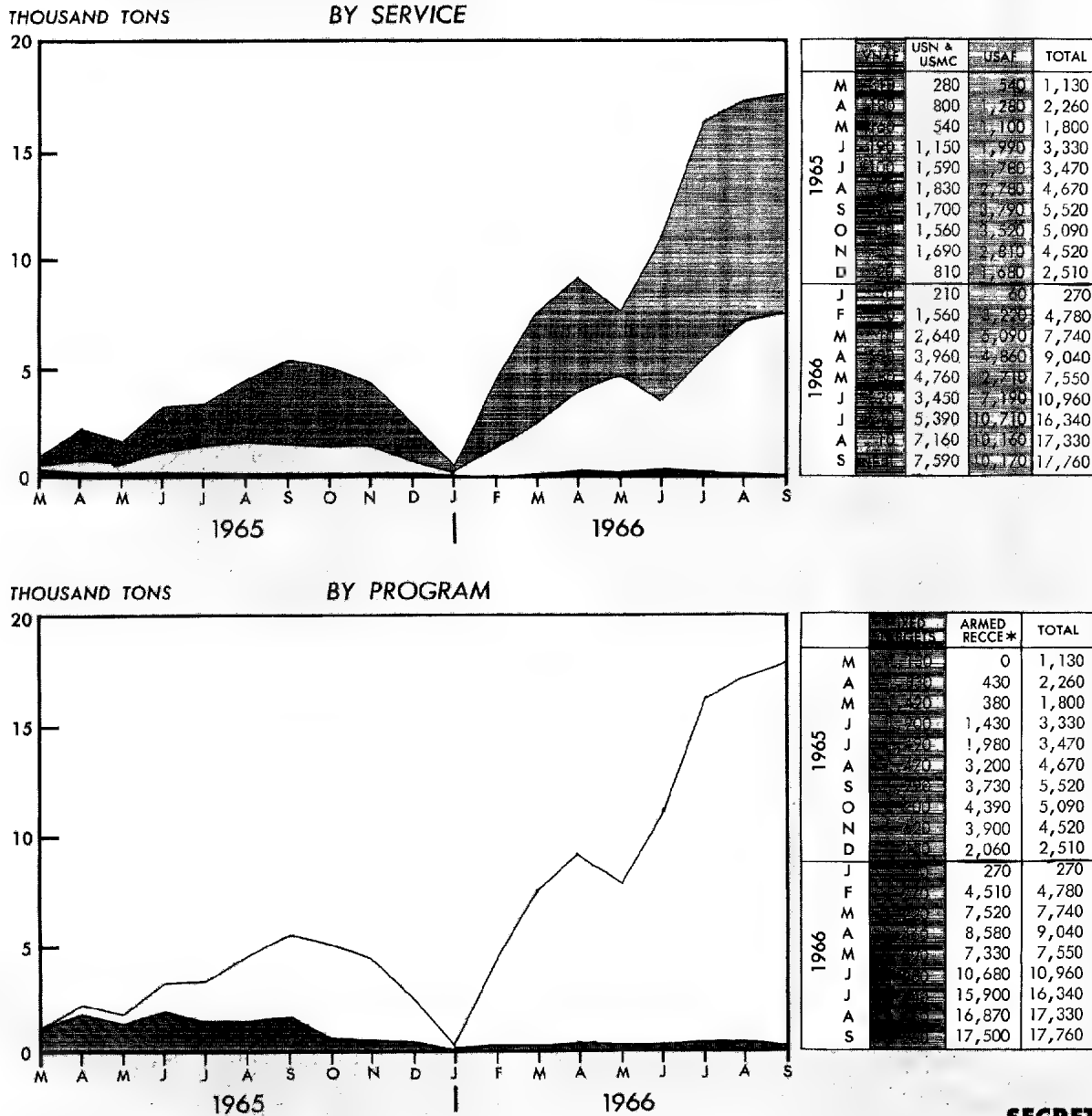
As indicated previously, the attack on JCS fixed targets has represented a much smaller effort in 1966 than it did in 1965. Only 2,010 sorties were flown against such targets in 1966, compared with 13,890 sorties in 1965, and only 2,610 tons of ordnance were delivered, compared with 12,800 last year (see Table A18). As of 30 September 1966, there were 242 targets on the JCS list. A total of 153 targets from the list were struck in 1965, including some no longer carried on the current list. During the first nine months of 1966, 22 new targets were struck, and 65 that had been struck previously were restruck (see Table A19). The effort against the individual target systems is summarized in Table A20, and is presented in greater detail in Tables A21 through A28.

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## ORDNANCE DELIVERED ON NORTH VIETNAM

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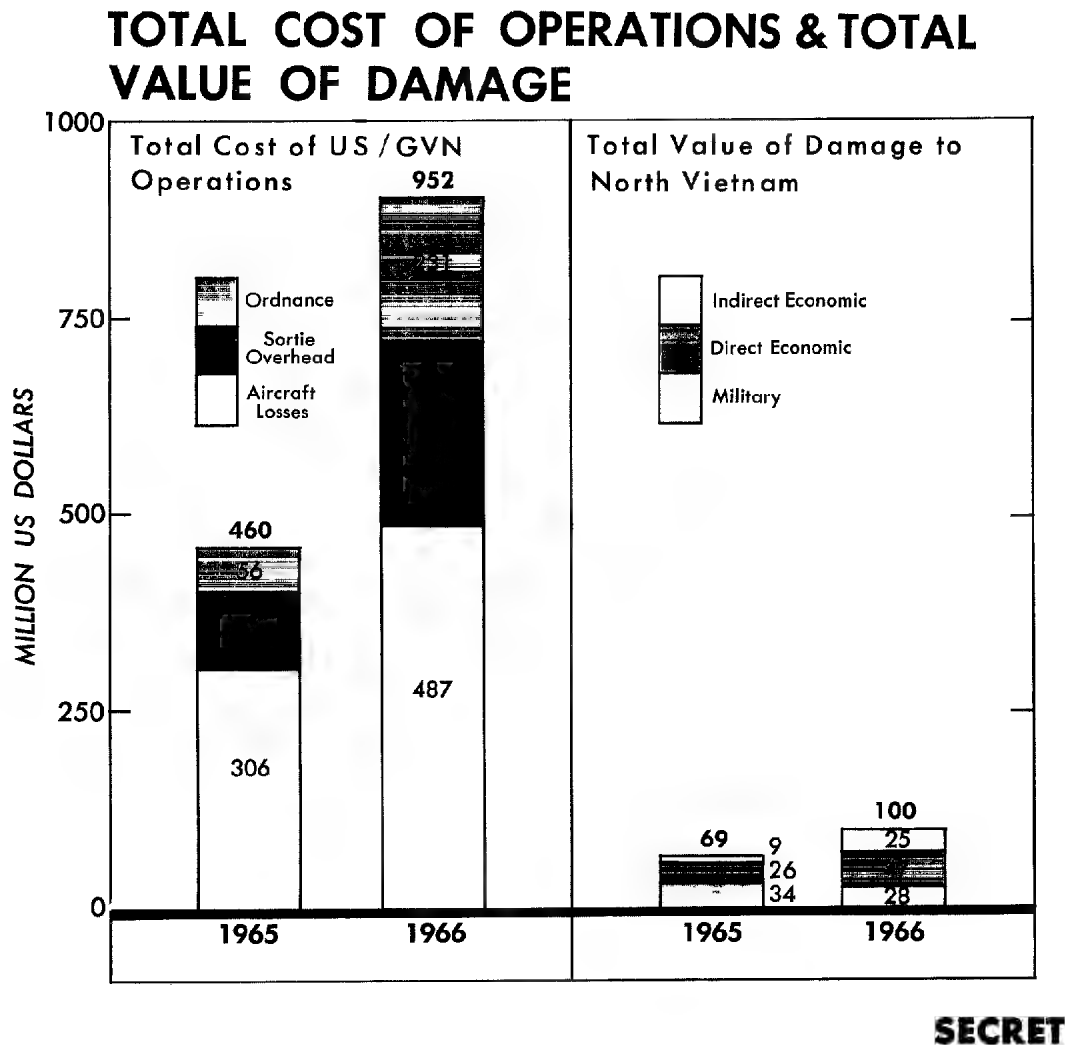


\* Not on JCS Fixed Targets

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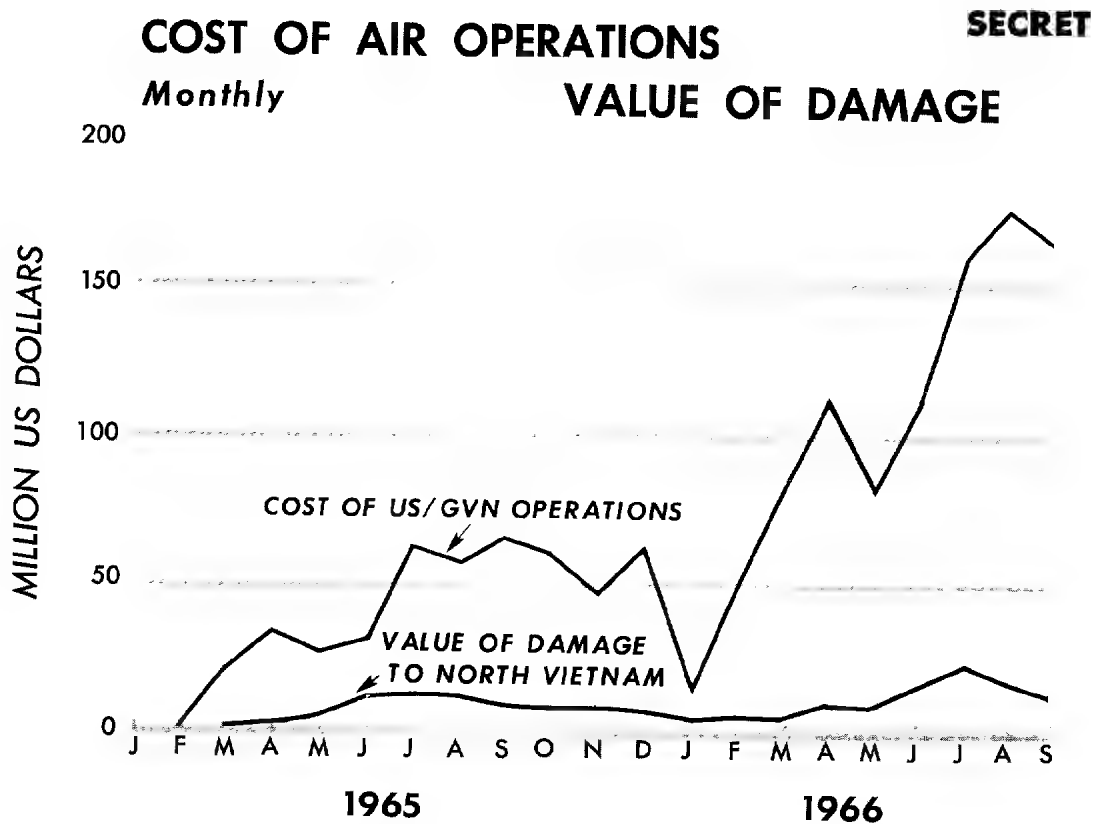
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Figure A-8. Monthly Summary of Ordnance Delivered on North Vietnam, by Service and by Program, March 1965-September 1966



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Figure A-9. Estimated Direct Operational Cost of US/GVN Air Operations in North Vietnam and Cost of Economic and Military Damage to North Vietnam, 1965 and January-September 1966



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Figure A-10. Estimated Direct Operational Cost of US/GVN Air Operations in North Vietnam and Cost of Economic and Military Damage to North Vietnam, by Month, 1965 and January-September 1966

Approved For Release 2006/09/28 : CIA-RDP8702095R000300070001-9  
1965 and January-September 1966

	North Vietnam								South Vietnam				Laos				All Areas of Operation in Southeast Asia			
	Sorties		Percent of Total Sorties		Ordnance (Tons)		Percent of Total Ordnance		Sorties	Percent of Total Sorties	Ordnance (Tons)	Percent of Total Ordnance	Sorties	Percent of Total Sorties	Ordnance (Tons)	Percent of Total Ordnance	Sorties	Percent of Total Sorties	Ordnance (Tons)	Percent of Total Ordnance
	1965	1966	1965	1966	1965	1966	1965	1966												
US																				
Air Force	24,500	51,900	44.4	51.8	21,300	54,170	62.1	59.0	67,770	44.7	117,240	59.9	41,240	72.3	42,350	70.9	163,910	52.1	213,760	61.6
Navy	29,100	46,570	52.7	43.9	11,900	33,890	34.7	36.9	23,530	15.5	21,750	11.1	8,470	14.8	9,140	15.3	78,570	25.0	64,780	18.7
Marine Corps	890	3,690	1.6	3.5	N.A.	2,830		3.1	35,350	23.3	28,480	14.6	7,350	12.9	8,260	13.8	46,390	14.7	39,570	11.4
Army									N.A.	N.A.	5,630	11.5					N.A.		5,630	1.6
Total US	<u>54,490</u>	<u>105,160</u>	<u>98.7</u>	<u>99.2</u>	<u>33,200</u>	<u>90,890</u>	<u>96.8</u>	<u>99.0</u>	<u>126,650</u>	<u>83.5</u>	<u>173,100</u>	<u>97.1</u>	<u>57,060</u>	<u>100.0</u>	<u>59,750</u>	<u>100.0</u>	<u>288,870</u>	<u>91.8</u>	<u>323,740</u>	<u>93.3</u>
VNAF	720	810	1.3	0.8	1,100	880	3.2	1.0	24,990	16.5	22,600	2.9					25,800	8.2	23,480	6.7
Total	<u>55,210</u>	<u>105,970</u>	<u>100.0</u>	<u>100.0</u>	<u>34,300</u>	<u>91,770</u>	<u>100.0</u>	<u>100.0</u>	<u>151,640</u>	<u>100.0</u>	<u>195,700</u>	<u>100.0</u>	<u>57,060</u>	<u>100.0</u>	<u>59,750</u>	<u>100.0</u>	<u>314,670</u>	<u>100.0</u>	<u>347,220</u>	<u>100.0</u>

Table A2

Sorties Over All Areas of Operation in Southeast Asia, by Mission and Nationality <sup>a/</sup>  
1965 and January-September 1966

Year and Month	By US Services			By the South Vietnamese Air Force			Total		
	Attack Sorties <sup>b/</sup>	Support Sorties	Total Sorties	Attack Sorties <sup>b/</sup>	Support Sorties	Total Sorties	Attack Sorties <sup>b/</sup> <sup>c/</sup>	Support Sorties <sup>c/</sup>	Total Sorties
1965									
January	800	430	1,230	N.A.	N.A.	1,630			2,860
February	1,410	610	2,020	N.A.	N.A.	1,390			3,410
March	2,690	910	3,600	N.A.	N.A.	1,430			5,030
April	4,620	2,570	7,190	N.A.	N.A.	1,600			8,790
May	7,240	3,670	10,910	N.A.	N.A.	1,440			12,350
June	8,620	2,190	10,810	N.A.	N.A.	1,540			12,350
July	12,440	5,220	17,660	N.A.	N.A.	2,180			19,840
August	13,060	5,500	18,560	N.A.	N.A.	2,470			21,030
September	14,130	5,760	19,890	N.A.	N.A.	2,590			22,480
October	13,940	6,850	20,790	N.A.	N.A.	3,000			23,790
November	14,980	6,530	21,510	N.A.	N.A.	2,710			24,220
December	15,740	7,010	22,750	N.A.	N.A.	2,650			25,400
Total 1965	<u>109,670</u>	<u>47,250</u>	<u>156,920</u>	<u>N.A.</u>	<u>N.A.</u>	<u>24,630</u>			<u>181,550</u>
1966									
January	17,890	8,220	26,110	2,470	50	2,520	20,360	8,270	28,630
February	18,730	7,850	26,580	2,800	40	2,840	21,530	7,890	29,420
March	23,630	9,790	33,420	2,880	60	2,940	26,510	9,850	36,360
April	20,860	10,560	31,420	2,540	100	2,640	23,400	10,660	34,060
May	18,400	9,300	27,700	2,570	110	2,680	20,970	9,410	30,380
June	21,480	10,950	32,430	2,980	80	3,060	24,460	11,030	35,490
July	24,710	13,020	37,730	3,130	110	3,240	27,840	13,130	40,970
August	24,280	12,120	36,400	2,980	140	3,120	27,260	12,260	39,520
September	24,330	12,750	37,080	2,530	230	2,760	26,860	12,980	39,840
Total first nine months 1966	<u>194,310</u>	<u>94,560</u>	<u>288,870</u>	<u>24,880</u>	<u>920</u>	<u>25,800</u>	<u>219,190</u>	<u>95,480</u>	<u>314,670</u>
Total January 1965 - September 1966	<u>303,980</u>	<u>141,810</u>	<u>445,790</u>			<u>50,430</u>			<u>496,220</u>

a. Rounded to nearest 10 sorties.

b. Attack sorties include strike and flak-suppression sorties and close air support of ground operations.

c. The distribution of South Vietnamese sorties by attack and support categories is not available for 1965.

Table A3

Sorties Over South Vietnam by Mission and Nationality a/  
1965 and January-September 1966

Year and Month	By US Services			By the South Vietnamese Air Force			Total		
	Attack Sorties <u>b/</u>	Support Sorties	Total Sorties	Attack Sorties <u>b/</u>	Support Sorties	Total Sorties	Attack Sorties <u>b/ c/</u>	Support Sorties <u>c/</u>	Total Sorties
1965									
January	740	270	1,010	N.A.	N.A.	1,630			2,640
February	1,200	260	1,460	N.A.	N.A.	1,330			2,790
March	1,860	300	2,160	N.A.	N.A.	1,310			3,470
April	2,290	310	2,600	N.A.	N.A.	1,490			4,090
May	4,940	500	5,440	N.A.	N.A.	1,320			6,760
June	5,800	330	6,130	N.A.	N.A.	1,440			7,570
July	8,270	1,880	10,150	N.A.	N.A.	2,100			12,250
August	8,910	1,430	10,340	N.A.	N.A.	2,430			12,770
September	9,120	1,210	10,330	N.A.	N.A.	2,570			12,900
October	9,510	1,870	11,380	N.A.	N.A.	2,990			14,370
November	10,380	1,960	12,340	N.A.	N.A.	2,700			15,040
December	10,520	2,540	13,060	N.A.	N.A.	2,600			15,660
Total 1965	<u>73,540</u>	<u>12,860</u>	<u>86,400</u>	<u>N.A.</u>	<u>N.A.</u>	<u>23,910</u>			<u>110,310</u>
1966									
January	9,680	2,990	12,670	2,470	50	2,520	12,150	3,040	15,190
February	10,570	2,760	13,330	2,800	40	2,840	13,370	2,800	16,170
March	12,760	3,200	15,960	2,870	50	2,920	15,630	3,250	18,880
April	9,340	3,010	12,350	2,400	100	2,500	11,740	3,110	14,850
May	9,620	2,890	12,510	2,460	110	2,570	12,080	3,000	15,080
June	10,400	3,080	13,480	2,710	80	2,790	13,110	3,160	16,270
July	12,540	4,510	17,050	2,890	110	3,000	15,430	4,620	20,050
August	11,670	3,340	15,010	2,960	140	3,100	14,630	3,480	18,110
September	10,730	3,560	14,290	2,520	230	2,750	13,250	3,790	17,040
Total first nine months 1966	<u>27,310</u>	<u>29,340</u>	<u>126,650</u>	<u>24,080</u>	<u>910</u>	<u>24,990</u>	<u>121,390</u>	<u>30,250</u>	<u>151,640</u>
Total January 1965 - September 1966	<u>170,850</u>	<u>42,200</u>	<u>213,050</u>			<u>48,900</u>			<u>261,950</u>

a. Rounded to nearest 10 sorties.

b. Attack sorties include strike and flak-suppression sorties.

c. The distribution of South Vietnamese sorties by attack and support categories is not available for 1965.

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Table A4

United States Sorties Over Laos, by Mission a/  
1965 and January-September 1966

<u>Year and Month</u>	<u>Attack Sorties b/</u>	<u>Support Sorties</u>	<u>Total Sorties</u>
1965			
January	60	160	220
February	80	280	360
March	300	370	670
April	830	900	1,730
May	790	460	1,250
June	510	330	840
July	1,010	380	1,390
August	730	280	1,010
September	1,020	320	1,340
October	970	430	1,400
November	1,480	390	1,870
December	3,050	900	3,950
Total 1965	<u>10,830</u>	<u>5,200</u>	<u>16,030</u>
1966			
January	8,080	2,340	10,420
February	5,350	1,380	6,730
March	6,390	1,650	8,040
April	6,210	2,460	8,670
May	4,420	2,160	6,580
June	3,560	2,440	6,000
July	2,210	2,270	4,480
August	820	1,750	2,570
September	1,260	2,310	3,570
Total first nine months 1966	<u>38,300</u>	<u>18,760</u>	<u>57,060</u>
Total January 1965 - September 1966	<u>49,130</u>	<u>23,960</u>	<u>73,090</u>

a. Rounded to nearest 10 sorties.

b. Attack sorties include strike and flak-suppression sorties.

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Table A5

Ordnance Delivered by Air in Southeast Asia  
by Month  
March-December 1965 and  
January-September 1966

<u>Year and Month</u>	<u>Country</u>			<u>Tons</u>
	<u>North Vietnam</u>	<u>South Vietnam</u>	<u>Laos</u>	<u>Total</u>
1965				
March	1,130	N.A.	N.A.	1,130
April	2,260	N.A.	N.A.	2,260
May	1,800	N.A.	N.A.	1,800
June	3,330	N.A.	N.A.	3,330
July	3,470	N.A.	N.A.	3,470
August	4,670	N.A.	N.A.	4,670
September	5,520	N.A.	N.A.	5,520
October	5,090	N.A.	N.A.	5,090
November	4,520	N.A.	N.A.	4,520
December	2,510	N.A.	N.A.	2,510
Total	<u>34,300</u>	<u>N.A.</u>	<u>N.A.</u>	<u>34,300</u>
1966				
January	270	23,870	13,920	38,060
February	4,780	21,810	10,880	37,470
March	7,740	24,090	8,980	40,810
April	9,040	18,920	9,290	37,250
May	7,550	18,080	7,130	32,760
June	10,960	19,030	4,520	34,510
July	16,340	23,880	2,360	42,580
August	17,330	25,590	1,440	44,360
September	17,760	20,430	1,230	39,420
Total	<u>91,770</u>	<u>195,700 a/</u>	<u>59,750</u>	<u>347,220</u>

a. Including 5,630 tons of ordnance expended by an unknown number of US Army sorties in South Vietnam.

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Table A6

Distribution of US Sorties from Each Launch Base  
to Target Areas in Southeast Asia  
January-September 1966

	Percent				
	From South Vietnam			From Thailand	From Naval Carriers
	By USAF	By USMC	All from South Vietnam	By USAF	By USN
To North Vietnam	15	10	10	65	55
To South Vietnam	65	75	70	0	25
To Laos	20	15	20	35	20
Total	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>	<u>100</u>

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Table A7

Aircraft Losses in Southeast Asia  
by Area of Operation, Nationality, and Type of Loss  
January-September 1966

Month	AREA OF OPERATION															
	North Vietnam			South Vietnam							Laos			Total Southeast Asia		
	NATIONALITY OF AIRCRAFT LOST															
	United States			United States <sup>a/</sup>			South Vietnam			United States			United States and South Vietnam			
	TYPE OF LOSS <sup>b/</sup>															
Combat	Operational	Total US	Combat	Operational	Total US	Combat	Operational	Total GVN	Total US and GVN	Combat	Operational	Total	Combat	Operational	Total	
January	3	0	3	8	7	15	2	1	3	18	5	2	7	18	10	28
February	9	0	9	3	0	3	0	1	1	2	11	1	12	23	2	25
March	24	1	25	11	1	12	1	1	2	14	3	4	7	39	7	46
April	29	5	34	4	3	7	3	1	4	11	8	0	8	44	9	53
May	20	2	22	3	5	8	2	1	3	11	11	1	12	36	9	45
June	21	6	27	4	3	7	2	0	2	9	6	0	6	33	9	42
July	43	1	44	4	2	6	2	2	4	10	1	0	1	50	5	55
August	37	9	46	3	6	9	0	1	1	10	1	0	1	41	16	57
September	36	3	39	8	4	12	0	0	0	12	2	1	3	46	8	54
Total	222	27	249	48	31	79	12	8	20	99	48	2	57	330	75	405

a. Excluding US Army aircraft losses.

b. Combat loss means the destruction of an aircraft on an attack or support mission by enemy fire. Operational loss means the destruction of an aircraft on an attack or support mission through aircraft malfunction or pilot error.

Table A8

Cost of Air Operations in Southeast Asia  
January-September 1966

Million US \$

1966	North Vietnam				South Vietnam				Laos				Total Southeast Asia			
	Losses	Sorties Overhead	Ordnance	Total	Losses	Sorties Overhead	Ordnance	Total	Losses	Sorties Overhead	Ordnance	Total	Losses	Sorties Overhead	Ordnance	Total
January	4.8	9.2	1.6	15.6	24.9	24.6	56.3	105.8	10.1	16.9	35.4	62.4	39.8	50.7	93.3	183.8
February	23.2	16.4	10.9	50.5	5.1	23.6	43.4	72.1	16.4	11.4	40.7	68.5	44.7	51.4	95.0	191.1
March	37.6	22.7	19.8	80.1	12.0	30.6	57.9	100.5	7.9	12.8	19.5	40.2	57.5	66.1	97.2	220.8
April	67.2	23.9	25.3	116.4	7.0	26.8	42.6	76.4	7.5	11.6	21.6	40.7	81.7	62.3	89.5	233.5
May	48.1	16.5	18.3	82.9	12.4	25.8	57.4	95.6	13.1	8.8	19.6	41.5	73.6	51.1	95.3	220.0
June	49.4	29.0	30.4	108.8	8.1	26.9	54.9	89.9	0.6	7.3	19.8	27.7	58.1	63.2	105.1	226.4
July	81.7	35.3	41.7	158.7	9.0	31.4	52.6	93.0	0.4	4.9	6.3	11.6	91.1	71.6	100.6	263.3
August	99.0	37.7	38.4	175.1	14.1	30.3	44.2	88.6	0.4	2.3	5.2	7.9	113.5	70.3	87.8	271.6
September	75.8	43.2	44.7	163.7	16.2	27.8	49.1	93.1	0.9	2.8	3.5	7.2	92.9	73.8	97.3	264.0
Total	<u>486.8</u>	<u>233.9</u>	<u>231.1</u>	<u>951.8</u>	<u>108.8</u>	<u>247.8</u>	<u>458.4</u>	<u>815.0</u>	<u>57.3</u>	<u>78.8</u>	<u>171.6</u>	<u>307.7</u>	<u>652.9</u>	<u>560.5</u>	<u>861.1</u>	<u>2,074.5</u>

Table A9

Sorties Over North Vietnam, by Mission and Nationality a/  
1965 and January-September 1966

Year and Month	By US Services			By South Vietnamese Air Force			Total		
	Attack Sorties <u>b/</u>	Support Sorties	Total Sorties	Attack Sorties <u>b/</u>	Support Sorties	Total Sorties	Attack Sorties <u>b/</u>	Support Sorties	Total Sorties
1965									
January	0	0	0	0	0	0	0	0	0
February	130	70	200	60	0	60	190	70	260
March	530	240	770	120	Negl.	120	650	240	890
April	1,500	1,360	2,860	100	10	110	1,600	1,370	2,970
May	1,510	2,710	4,220	100	20	120	1,610	2,730	4,340
June	2,310	1,530	3,840	90	10	100	2,400	1,540	3,940
July	3,160	2,960	6,120	70	10	80	3,230	2,970	6,200
August	3,420	3,790	7,210	30	10	40	3,450	3,800	7,250
September	3,990	4,230	8,220	20	Negl.	20	4,010	4,230	8,240
October	3,460	4,550	8,010	10	Negl.	10	3,470	4,550	8,020
November	3,120	4,180	7,300	10	Negl.	10	3,130	4,180	7,310
December	2,170	3,570	5,740	30	20	50	2,200	3,590	5,790
Total 1965	<u>25,300</u>	<u>29,190</u>	<u>54,490</u>	<u>640</u>	<u>80</u>	<u>720</u>	<u>25,940</u>	<u>29,270</u>	<u>55,210</u>
1966									
January	130	2,890	3,020	0	0	0	130	2,890	3,020
February	2,810	3,710	6,520	0	0	0	2,810	3,710	6,520
March	4,480	4,940	9,420	10	10	20	4,490	4,950	9,440
April	5,310	5,090	10,400	140	0	140	5,450	5,090	10,540
May	4,360	4,250	8,610	110	0	110	4,470	4,250	8,720
June	7,520	5,430	12,950	270	0	270	7,790	5,430	13,220
July	9,960	6,240	16,200	240	0	240	10,200	6,240	16,440
August	11,790	7,030	18,820	20	0	20	11,810	7,030	18,840
September	12,340	6,880	19,220	10	0	10	12,350	6,880	19,230
Total first nine months 1966	<u>58,700</u>	<u>46,460</u>	<u>105,160</u>	<u>800</u>	<u>10</u>	<u>810</u>	<u>59,500</u>	<u>46,470</u>	<u>105,970</u>
Total January 1965 - September 1966	<u>84,000</u>	<u>75,650</u>	<u>159,650</u>	<u>1,440</u>	<u>90</u>	<u>1,530</u>	<u>85,440</u>	<u>75,740</u>	<u>161,180</u>

a. Rounded to nearest ten sorties. Negl. includes less than five sorties.

b. Attack sorties include strike and flak-suppression sorties.

Table A10

Sorties Against North Vietnam, by Program and by Service  
1965 and January-September 1966

Year and Month	On Fixed Targets		On Armed Reconnaissance				Services			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Total on Fixed Targets (Col. 2 & 3)	By Fixed Target Strikes	By Armed Reconnaissance Strikes	Armed Reconnaissance Not on Fixed Targets	Total on Armed Reconnaissance (Col. 3 & 4)	Total (Col. 1 & 4)	United States			South Vietnamese Air Force
							Air Force	Navy	Marine	
1965										
January	0	0	0	0	0	0	0	0	0	0
February	0	0	0	260	260	260	80	120	N.A.	60
March	850	850	0	40	40	890	360	410	N.A.	120
April	1,800	1,460	340	1,170	1,510	2,970	1,200	1,660	N.A.	120
May	1,790	1,300	490	2,550	3,040	4,340	2,280	1,940	N.A.	120
June	1,410	1,360	50	2,550	2,580	3,940	1,840	2,000	N.A.	100
July	1,910	1,590	320	4,290	4,610	6,200	2,380	3,600	140	80
August	1,900	1,390	510	5,350	5,860	7,250	3,030	4,030	150	40
September	1,600	1,440	160	6,640	6,800	8,240	3,690	4,160	170	20
October	770	570	200	7,250	7,450	8,020	3,480	4,370	160	10
November	1,040	570	470	6,270	6,740	7,310	3,330	3,830	140	10
December	820	530	290	4,970	5,260	5,790	2,630	2,980	130	50
Total	14,890	11,060	2,830	41,320 a/	44,150 a/	55,210 a/	24,500	29,100	890	720
1966										
January	0	0	0	3,020	3,020	3,020	1,570	1,220	230	0
February	170	0	170	6,350	6,520	6,520	3,190	3,160	170	0
March	180	0	180	9,280	9,460	9,460	4,600	4,630	190	20
April	390	50	340	10,150	10,490	10,540	4,850	5,410	140	140
May	160	0	160	8,560	8,720	8,720	4,060	4,420	130	110
June	320	240	80	12,900	12,980	13,220	7,340	5,420	190	270
July	360	50	310	16,080	16,390	16,440	9,520	6,100	580	240
August	280	20	260	18,560	18,820	18,840	9,660	8,120	1,040	20
September	150	0	150	19,080	19,230	19,230	10,110	8,090	1,020	10
Total	2,010	360	1,650	103,960	105,610	105,970	54,900	46,570	3,690	810

a. Also including 645 miscellaneous sorties such as leaflet drops, gift drops, and photoreconnaissance sorties not accompanying a strike mission.

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Table All

Distribution of Sorties to Each Target Country,  
by Launch Base in Southeast Asia  
January-September 1966

	Percent		
	<u>To North Vietnam</u>	<u>To South Vietnam</u>	<u>To Laos</u>
From South Vietnam			
By USAF	16	46	30
By USMC	3	21	10
By VNAF	1	16	
Total	<u>20</u>	<u>83</u>	<u>40</u>
From Thailand			
By USAF	36	0	30
From naval carriers			
By USN	44	17	30
Total	<u>100</u>	<u>100</u>	<u>100</u>

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Table A12

Distribution of Sorties over North Vietnam,  
by Route Package a/  
January-September 1966

							Percent	
	Route Package							
<u>Month</u>	<u>I</u>	<u>II</u>	<u>III</u>	<u>IV</u>	<u>V</u>	<u>VI</u>	<u>Unknown</u>	<u>Total</u>
January	17	18	30	4	3		28	100
February	31	24	15	3	5		22	100
March	34	31	13	5	11		6	100
April	37	29	17	3	6	3	5	100
May	30	19	26	10	6	4	5	100
June	49	19	14	8	1	4	5	100
July	47	18	12	5	4	8	6	100
August	35	16	11	9	1	12	16	100
September	39	16	12	17	5	8	3	100
Nine-month average	39	19	15	9	4	7	7	100

a. North Vietnam is divided, for operations, into six geographic areas, known as Route Packages. For the location of Route Package areas, see Figure A7.

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Table A13

Ordnance Delivered by Air on North Vietnam, by Month and by Program  
March-December 1965 and January-September 1966

Year and Month	On JCS Fixed Targets			On Armed Reconnaissance		Tons
	(1)	(2)	(3)	(4)	(5)	Total
	Total on JCS Fixed Targets (Col. 2 & 3)	By Fixed Target Strikes	By Armed Reconnaissance Strike	Armed Reconnaissance Not on Fixed Targets	Total on Armed Reconnaissance (Col. 3 & 4)	Total (Col. 1 & 4)
1965						
March	1,130	1,130	0	0	0	1,130
April	1,830	1,620	210	430	640	2,260
May	1,420	1,420	0	380	380	1,800
June	1,900	1,900	0	1,430	1,430	3,330
July	1,490	1,410	80	1,580	2,060	3,470
August	1,470	1,280	190	3,200	3,390	4,670
September	1,790	1,780	10	3,730	3,740	5,520
October	700	590	110	4,390	4,500	5,090
November	620	480	140	3,900	4,040	4,520
December	450	350	100	2,060	2,160	2,510
Total	<u>12,800</u>	<u>11,960</u>	<u>840</u>	<u>21,500</u>	<u>22,340</u>	<u>34,300</u>
1966						
January	0	0	0	270	270	270
February	270	0	270	4,510	4,780	4,780
March	220	0	220	7,520	7,740	7,740
April	460	80	380	8,580	8,960	9,040
May	220	0	220	7,330	7,550	7,550
June	280	190	90	10,680	10,770	10,960
July	440	60	380	15,900	16,280	16,340
August	460	40	420	16,870	17,290	17,330
September	260	0	260	17,500	17,760	17,760
Total	<u>2,610</u>	<u>370</u>	<u>2,240</u>	<u>89,160</u>	<u>91,400</u>	<u>91,770</u>



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Table A14

Ordnance Delivered on North Vietnam,  
by Month and by Service  
March 1965-September 1966

	Tons				
<u>Year and Month</u>	<u>USAF</u>	<u>USN</u>	<u>USMC</u>	<u>VNAF</u>	<u>Total</u>
1965					
March	540	280		310	1,130
April	1,280	800		180	2,260
May	1,100	540		160	1,800
June	1,990	1,150		190	3,330
July	1,780	1,590		100	3,470
August	2,780	1,830		60	4,670
September	3,790	1,700		30	5,520
October	3,520	1,560		10	5,090
November	2,810	1,690		20	4,520
December	1,680	810		20	2,510
Total	<u>21,270</u>	<u>11,950</u>		<u>1,080</u>	<u>34,300</u>
1966					
January	60	210	0	0	270
February	3,220	1,550	10	0	4,780
March	5,090	2,610	30	10	7,740
April	4,860	3,960	Negl.	220	9,040
May	2,710	4,760	0	80	7,550
June	7,190	3,450	0	320	10,960
July	10,710	4,860	530	240	16,340
August	10,160	6,090	1,070	10	17,330
September	10,170	6,400	1,190	Negl.	17,760
Total	<u>54,170</u>	<u>33,890</u>	<u>2,830</u>	<u>880</u>	<u>91,770</u>

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Table A15

Aircraft and Personnel Losses in Attacks on  
North Vietnam, by Service  
1965 and January-September 1966

	<u>Service</u>	<u>Aircraft</u>	<u>Personnel</u>	
			<u>Lost</u>	<u>Recovered</u>
1965				
	USAF	77	62	30
	USN	86	76	30
	USMC	0	0	0
	VNAF	8	6	2
Total		<u>171</u>	<u>144</u>	<u>62</u>
1966				
	USAF	142	132	70
	USN	104	68	60
	USMC	3	8	1
	VNAF	0	0	0
Total		<u>249 a/</u>	<u>208</u>	<u>131</u>

a. Including 222 combat and 27 operational losses.

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Table A16

Losses by Model of Aircraft in Operations Against North Vietnam  
1965 and January-September 1966

Aircraft Model	1965			January-September 1966		
	Number of Aircraft Lost	Total Sorties Flown by this Model Aircraft	Losses as a Percent of Total Sorties Flown by this Model Aircraft	Number of Aircraft Lost	Total Sorties Flown by this Model Aircraft	Losses as a Percent of Total Sorties Flown by this Model Aircraft
F105	54	9,217	0.6	86	12,537	0.7
F4	19	6,203	0.3	33	8,437	0.4
A1	26	3,546	0.7	24	4,845	0.5
A4	29	8,951	0.3	47	12,175	0.4
F8	15	3,600	0.1	15	4,897	0.3
A6	3	506	0.6	8	687	1.2
RF101	6	299	2.0	11	406	2.7
RF8	6	364	1.6	6	495	1.2
EA1	1	726	0.1	2	987	0.2
F104	0	696	0	3	946	0.3
RA3	0	26	0	1	36	2.8
KA4	0	701	0	1	953	0.1
RA5	3	141	2.1	2	191	1.0
A3	0	109	0	1	147	0.7
B57	1	149	0.7	1	203	0.5
CL30	0	51	0	1	69	1.4
F100	5	418	1.2	1	610	0.2
HU16	0	0	0	1	N.A.	
RB66	0	288	0	2	391	0.5
RC47	0	0	0	1	N.A.	
EF10	0	455	0	1	618	0.2
KC130	0	4	0	1	5	20.0
SH3A	3	6	50.0	0	0	0
Total	171	36,456 a/	0.5	249 b/	49,635 a/	0.5

a. Including only sorties by aircraft models for which losses occurred in either 1965 or 1966.  
b. Including 222 combat losses and 27 operational losses.

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Table A17

Direct Operational Costs Related to Costs of Damage  
to the Economy of North Vietnam  
January 1965-September 1966

Million US\$

<u>Year and Month</u>	<u>US/GVN Operational Costs</u>				<u>Cost to North Vietnam</u>
	<u>Aircraft Losses</u>	<u>Sortie Overhead</u>	<u>Ordnance</u>	<u>Total</u>	
1965					
January	0	0	0	0	0
February	0	0.4	N.A.	0.4	0
March	18.8	1.4	1.7	21.9	1.7
April	23.3	5.1	3.6	32.0	3.6
May	14.6	7.6	3.9	26.1	4.4
June	18.8	6.9	5.7	31.4	9.7
July	45.0	11.0	5.1	61.1	11.6
August	34.5	13.0	8.6	56.1	10.9
September	39.0	14.8	10.6	64.4	6.7
October	39.4	14.4	5.8	59.6	7.1
November	27.2	13.1	7.4	47.7	7.0
December	45.2	10.3	3.8	59.3	6.4
Total	<u>305.8</u>	<u>98.0</u>	<u>56.2</u>	<u>460.0</u>	<u>69.1</u>
1966					
January	4.8	9.2	1.6	15.6	3.1
February	23.2	16.4	10.9	50.5	6.1
March	37.6	22.7	19.8	80.1	5.7
April	67.2	23.9	25.3	116.4	10.4
May	48.1	16.5	18.3	82.9	8.5
June	49.4	29.0	30.4	108.8	14.9
July	81.7	35.3	41.7	158.7	20.8
August	99.0	37.7	38.4	175.1	17.0
September	75.8	43.2	44.7	163.7	13.3
Total	<u>486.8</u>	<u>233.9</u>	<u>231.1</u>	<u>951.8</u>	<u>99.8</u>

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Table A18

Attack on JCS Fixed Targets in North Vietnam  
1965 and January-September 1966

Year and Program	Sorties Flown		Total		Ordnance Delivered	
	Strike and Flak Suppression	Support	Number	Percent	Tons	Percent
1965						
Fixed target	6,930	4,130	11,060	80	11,960	93
Armed reconnaissance	1,780	1,050	2,830	20	840	7
Total	<u>8,710</u>	<u>5,180</u>	<u>13,890</u>	<u>100</u>	<u>12,800</u>	<u>100</u>
January-September 1966						
Fixed target	210	150	360	18	370	14
Armed reconnaissance	1,310	340	1,650	82	2,240	86
Total	<u>1,520</u>	<u>490</u>	<u>2,010</u>	<u>100</u>	<u>2,610</u>	<u>100</u>

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Table A19

Comparison of Strikes on Major JCS Fixed Target  
Systems in North Vietnam  
1965 and January-September 1966

JCS Fixed Target System	Number Targeted		Number of Targets Struck	
	As of 30 September 1966	Struck 1965	Restruck January-September 1966	New Strike January-September 1966
Airfields (11)	11	4	1	0
Lines of communication (74)				
Bridges	61	47 a/	26	6
Railroad yards and shops	5	1	1	1
Locks	8	1	0	1
Military installations (130)				
Barracks/supply depots/ammunition depots/military complexes	91	70 b/	25	1
Petroleum storage	13	4	3	7
Ports and naval bases	15	4	3	2
Communication facilities	5	2	0	0
Radar sites	5	10 c/	3	1
SAM support facilities	1	1	0	0
SAM sites d/	0	2	0	1
Industrial installations (27)				
Electric power facilities	19	6	3	2
Manufacturing and explosives plants	8	1	0	0
Total	242	153 e/	65	22 f/

- a. Includes 2 bridges dropped from JCS Fixed Target List.  
b. Includes 4 barracks and 1 barracks/supply area dropped from JCS Fixed Target List.  
c. Includes 6 radar sites dropped from JCS Fixed Target List.  
d. Includes 2 SAM sites struck in 1965 and 1 in 1966 that have been dropped from the JCS Fixed Target List.  
e. Includes 15 targets dropped from the JCS Fixed Target List.  
f. Includes 1 target dropped from the JCS Fixed Target List.

Table A20

Comparison of Sorties and Ordnance  
on Major JCS Fixed Target Systems in North Vietnam  
1965 and January-September 1966

<u>JCS Fixed Target System</u>	<u>1965</u>	<u>January-September 1966</u>	<u>Total</u>
Barracks/supply depots/ammunition depots			
Attack sorties	4,290	260	4,550
Ordnance (tons)	7,300	390	7,690
POL storage			
Attack sorties	130	340	470
Ordnance (tons)	120	500	620
Powerplants			
Attack sorties	230	40	270
Ordnance (tons)	370	140	510
Manufacturing and explosives plants			
Attack sorties	20	N.A.	20
Ordnance (tons)	90	N.A.	90
Airfields			
Attack sorties	420	40	460
Ordnance (tons)	330	100	430
Bridges			
Attack sorties	2,420	610	3,030
Ordnance (tons)	3,200	1,120	4,320

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Table A20  
Comparison of Sorties and Ordnance  
on Major JCS Fixed Target Systems in North Vietnam  
1966 and January-September 1966  
(Continued)

<u>JCS Fixed Target System</u>	<u>1965</u>	<u>January-September 1966</u>	<u>Total</u>
Radar			
Attack Sorties	620	30	650
Ordnance (tons)	680	30	710
Naval bases, railroad yards, and ports			
Attack sorties	400	200	600
Ordnance (tons)	460	330	790
Total Attack sorties	<u>8,530 a/</u>	<u>1,520</u>	<u>10,050</u>
Total Ordnance	<u>12,550 a/</u>	<u>2,610</u>	<u>15,160</u>

a. Excluding 180 attack sorties and 250 tons of ordnance on railroad shops, locks, ferries, communications facilities, and surface-to-air missile support facilities.

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Table A21

Statistical Summary of Attacks on Airfields  
in North Vietnam  
1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	11	11	
JCS fixed targets struck	4	1	
Percent of national capacity destroyed	19	19	
Sorties			
Attack	420	40	460
Support	130	10	140
Total	<u>550</u>	<u>50</u>	<u>600</u>
Ordnance delivered (tons)	330	100	430
Cost to the United States (million \$)			
Aircraft lost	0	0	0
Operational cost of sorties flown	0.48	0.11	0.59
Ordnance delivered	0.40	0.13	0.53
Total	<u>0.88</u>	<u>0.24</u>	<u>1.12</u>

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Table A22

Statistical Summary of Attacks on Bridges  
in North Vietnam  
1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	61	61	
JCS fixed targets struck	47	32	
Percent of national capacity destroyed	49	51	
Sorties			
Attack	2,420	610	3,030
Support	1,710	250	1,960
Total	<u>4,130</u>	<u>860</u>	<u>4,990</u>
Ordnance delivered (tons)	3,200	1,120	4,320
Aircraft lost	37	5	42
Personnel lost	35	3	38
Personnel recovered	9	1	10
Unknown		1	1
Cost to the United States (million \$)	.	.	.
Aircraft lost	82.2	11.4	93.6
Operational cost of sorties flown	0.2	1.4	1.6
Ordnance delivered	4.1	1.3	5.4
Total	<u>86.5</u>	<u>14.1</u>	<u>100.6</u>

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Table A23

Statistical Summary of Attacks on Railroad  
Yards and Shops in North Vietnam  
1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	5	5	
JCS fixed targets struck	1	2	
Percent of national capacity destroyed	5.2	10.3	
Sorties			
Attack	80	100	180
Support	40	Nggl.	40
Total	<u>120</u>	<u>100</u>	<u>220</u>
Ordnance delivered (tons)	70	140	210
Aircraft lost	2	1	3
Personnel lost	1	1	2
Personnel recovered	1	0	1
Cost to US (million dollars)			
Aircraft lost	2.40	3.00	5.40
Operational cost of sorties flown	0.13	0.16	0.29
Ordnance delivered	0.04	0.17	0.21
Total	<u>2.57</u>	<u>3.33</u>	<u>5.90</u>

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Table A24

Statistical Summary of Attacks on Barracks, Supply  
Depots, Ammunition Depots, and Military Complexes  
in North Vietnam  
1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	92	91	
JCS fixed targets struck	70	26	
Percent of national capacity destroyed	N.A.	N.A.	
Sorties			
Attack	4,290	260	4,550
Support	1,730	20	1,750
Total	<u>6,020</u>	<u>280</u>	<u>6,300</u>
Ordnance delivered (tons)	7,300	390	7,690
Aircraft lost	15	1	16
Personnel lost	8	status unknown	
Personnel recovered	7	status unknown	
Cost to the United States (million \$)			
Aircraft lost	23.1	3.9	27.0
Operational cost of sorties flown	11.2	0.5	11.7
Ordnance delivered	9.1	0.5	9.6
Total	<u>43.4</u>	<u>4.9</u>	<u>48.3</u>

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Table A25

Statistical Summary of Attacks on Petroleum Storage  
in North Vietnam  
1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	13	13	
JCS fixed targets struck	4	10	
Percent of national capacity destroyed	17	60	
Sorties			
Attack	130	340	470
Support	120	180	300
Total	<u>250</u>	<u>520</u>	<u>770</u>
Ordnance delivered (tons)	120	500	620
Aircraft lost	1	5	6
Personnel lost	0	2	2
Personnel recovered	1	1	1
Unknown	0	2	2
Cost to the United States (million \$)			
Aircraft lost	1.3	8.20	9.50
Operational cost of sorties flown	0.3	0.85	1.15
Ordnance delivered	0.2	0.99	1.19
Total	<u>1.8</u>	<u>10.04</u>	<u>11.84</u>

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Table A26

Statistical Summary of Attacks on Ports and  
 Naval Bases in North Vietnam  
 1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	12	15	
JCS fixed targets struck	4	5	
Percent of national capacity destroyed	N.A.	N.A.	
Sorties:			
Attack	320	100	420
Support	110	20	130
Total	<u>430</u>	<u>120</u>	<u>550</u>
Ordnance Delivered (tons)	390	190	580
Aircraft lost	3	0	3
Personnel lost	3	0	3
Personnel recovered	0	0	0
Cost to US (million dollars)			
Aircraft lost	5.30	0.00	5.30
Operational cost of sorties flown	0.60	0.14	0.74
Ordnance delivered	0.40	0.23	0.63
Total	<u>6.30</u>	<u>0.37</u>	<u>6.67</u>

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Table A27

Statistical Summary of Attacks on Radar Sites  
in North Vietnam  
1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	5	5	
JCS fixed targets struck	10	4	
Percent of national capacity destroyed	58	80	
Sorties			
Attack	620	30	650
Support	350	Negl.	350
Total	<u>970</u>	<u>30</u>	<u>1,000</u>
Ordnance delivered (tons)	680	30	710
Aircraft lost	11	0	11
Personnel lost	3	0	3
Personnel recovered	9	0	9
Cost to the United States (million \$)			
Aircraft lost	N.A.	0	
Operational cost of sorties flown	N.A.	0.04	
Ordnance delivered	N.A.	0.06	
Total	<u>N.A.</u>	<u>0.10</u>	

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Table A28

Statistical Summary of Attacks on Powerplants  
in North Vietnam  
1965 and January-September 1966

	<u>1965</u>	<u>1966</u>	<u>Total</u>
Number of JCS fixed targets	18	19	
JCS fixed targets struck	6	5	
Percent of national capacity destroyed	27	32	
Sorties			
Attack	230	40	270
Support	260	0	260
Total	<u>490</u>	<u>40</u>	<u>530</u>
Ordnance delivered (tons)	370	140	510
Aircraft lost	4	0	4
Personnel lost	3	0	3
Personnel recovered	1	0	1
Cost to the United States (million \$)			
Aircraft lost	4.4	0	4.4
Operational cost of sorties flown	0.9	0.075	0.975
Ordnance delivered	0.7	0.070	0.770
Total	<u>6.0</u>	<u>0.145</u>	<u>6.145</u>

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## APPENDIX B

THE EFFECTS OF THE ROLLING THUNDER PROGRAMI. Physical Damage

The cost of reconstruction or repair of the economic and military facilities in North Vietnam which have been attacked under the Rolling Thunder program from January 1965 through September 1966 is estimated at \$170 million (see Figure B1). About 65 percent of the damage was inflicted on economic targets and 35 percent on military targets. The damage inflicted during the first three quarters of 1966 represents \$100 million of the total.

Damage to the economy accounts for more than 70 percent of the total in 1966, whereas in 1965 economic loss represented only about 50 percent. Destruction and damage to transport equipment accounted for slightly more than a third of the total economic damage in 1966 (see Figure B2). An equal amount was accounted for by indirect losses caused by shortfalls in agriculture, fishing, and exports. Bridges, powerplants, and petroleum storage sites were the principal categories of targets responsible for the remainder.

More than 80 percent of all military damage in 1966 resulted from attacks on aircraft, naval craft, and SAM sites, but in 1965 the damage from such attacks amounted to less than 20 percent of the total. Damage to barracks made up almost one-half of the total damage to military targets in 1965 but only a small portion of the total during 1966 (see Figure B3).

The greatest amount of damage inflicted in 1966 occurred in the months of June through September, with the peak month being July (see Figure B4). During these months the attacks on bulk petroleum storage began, and major losses in naval craft, aircraft, and transport equipment occurred. Damage to bridges also reached a peak in July. Indirect losses were at their highest point in June. During 1965 the monthly trend in physical damage was similar to that in 1966.

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**A. Economic****1. Petroleum Storage**

On 1 January 1965 there were 13 fixed (JCS) petroleum storage targets with a combined storage capacity of almost 128,000 tons.\* During 1965, nine airstrikes were made against four of these fixed targets -- three were completely destroyed and the facility at Vinh, which was damaged during the limited retaliation following the Gulf of Tonkin incidents in 1964,\*\* suffered further damage. About 26,000 tons of capacity -- about 20 percent of the total capacity on 1 January 1965 -- was destroyed in these attacks. The value of the tankage and contents and the related support facilities destroyed is estimated at \$1.6 million.

During the first nine months of 1966, 57 airstrikes were mounted against eight of the fixed petroleum storage targets. About 73,000 tons of capacity -- 56 percent of the total existing on 1 January 1965 (72 percent of the total on 1 January 1966) -- were destroyed. The value of the tankage and contents and the related support facilities destroyed is estimated at between \$4.4 million and \$5 million (see Table B1).\*\*\*

The total residual capacity at the nine fixed petroleum storage targets remaining on 30 September 1966 was about 29,000 tons, no single site having sufficient capacity to accept the cargo of a fully loaded 10,000-ton tanker. There was no indication that any of the attacked sites was being restored or reconstructed as of 30 September 1966. Recent photography revealed that cannibalization of moderately damaged tanks at Haiphong was under way.

In addition to the capacity of the JCS targeted facilities, the North Vietnamese since 1 January 1965 have developed additional capacity in dispersed tank sites. By 30 September 1966, more than

\* There was additional tankage of about 5,400 tons which existed on 1 January 1965 but which was subsequently removed, but the present whereabouts of this tankage is unknown. This tankage was not affected by bombings, is not now carried as usable capacity, and therefore is excluded from all calculations.

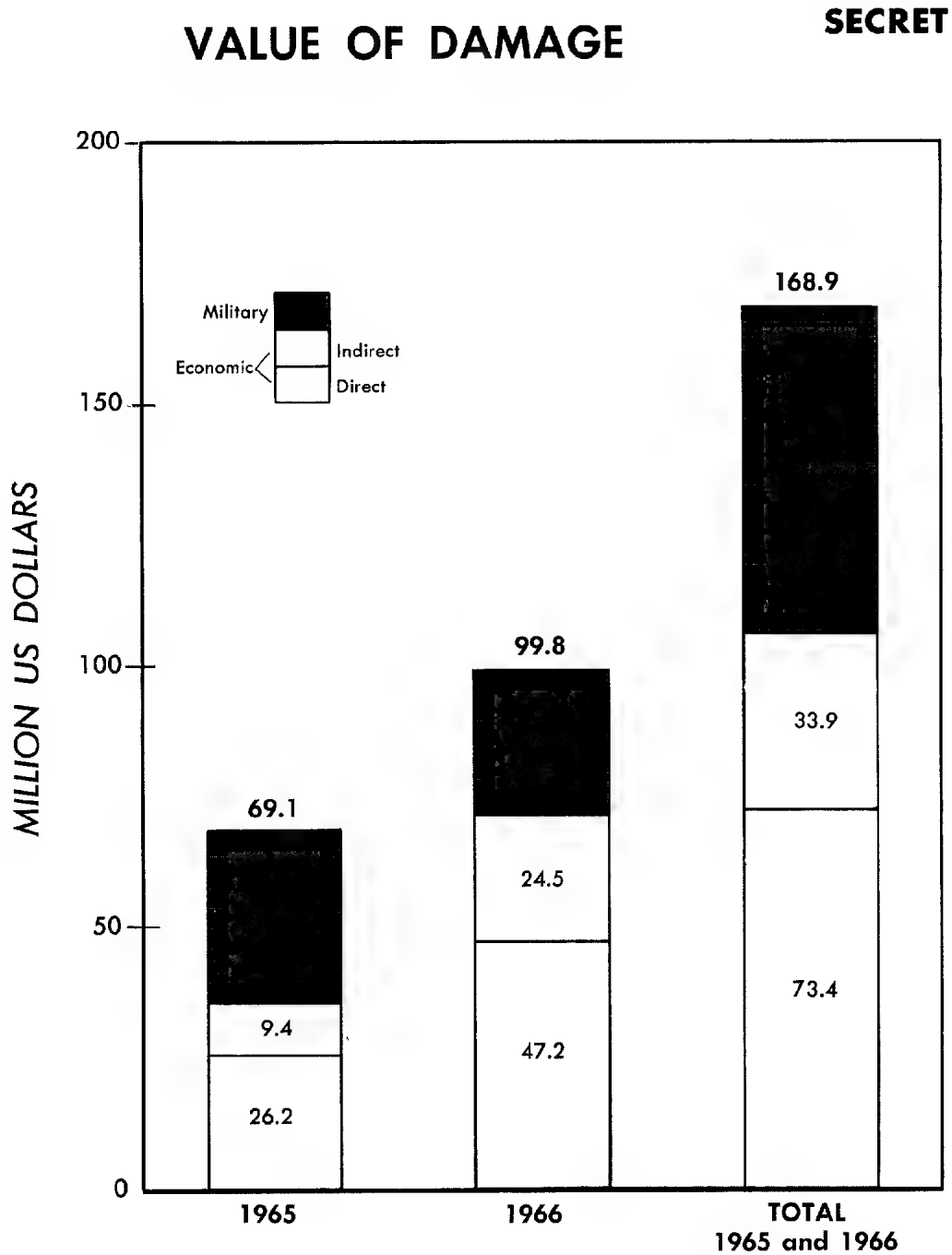
\*\* The capacity of the tankage destroyed at Vinh in 1964 -- about 4,000 tons -- is not included in the total capacity shown for 1 January 1965.

\*\*\* The range in value is necessary to reflect the possible range in the amount of petroleum in the tankage that was damaged (or destroyed).

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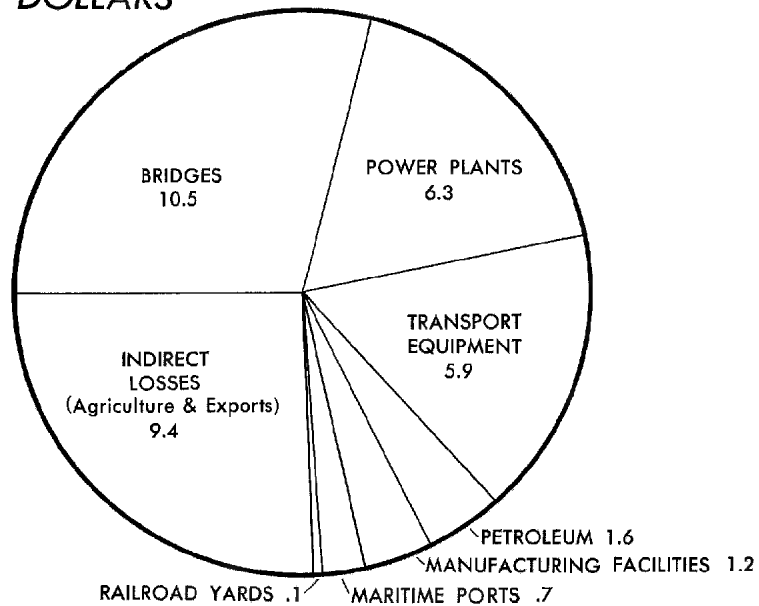
64085 12 66 CIA

Figure B-1. Value of Economic and Military Damage in North Vietnam, 1965 and January-September 1966

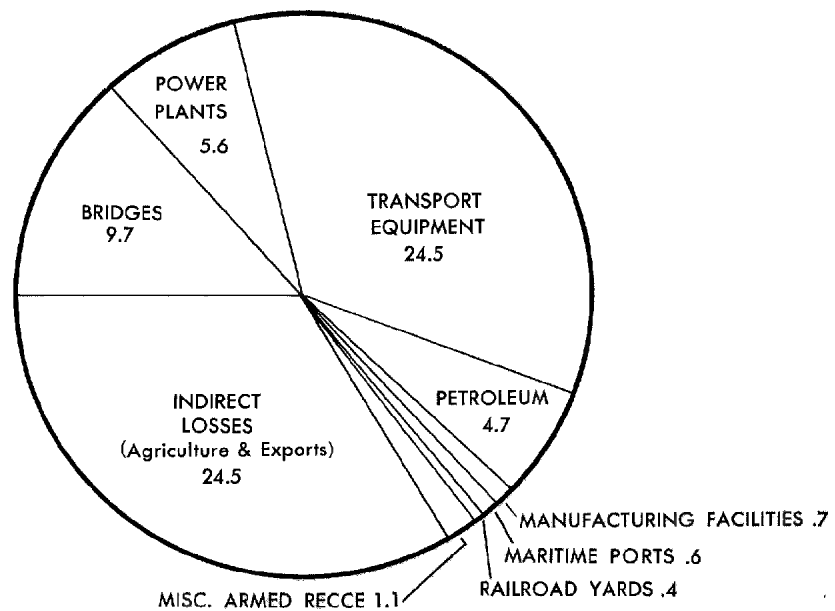
# ECONOMIC DAMAGE

MILLIONS US DOLLARS

**1965**  
35.6



**1966**  
71.7



64988 12-66 CIA

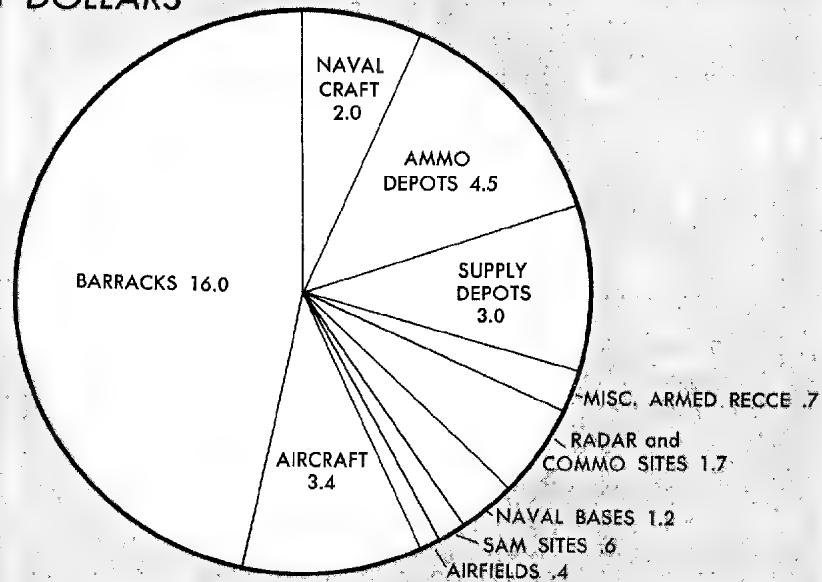
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Figure B-2. Value of Economic Damage in North Vietnam, by Sector, 1965 and January-September 1966

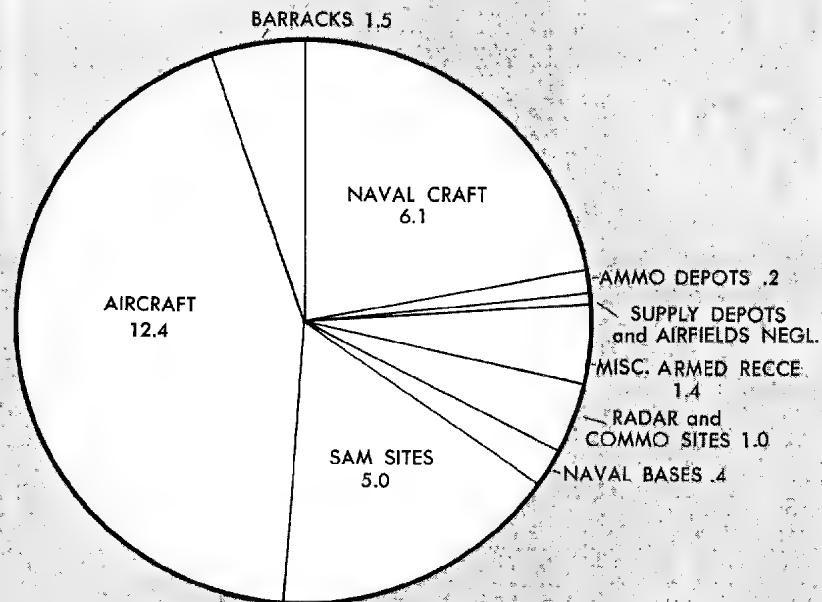
# MILITARY DAMAGE

MILLIONS US DOLLARS

**1965**  
33.5

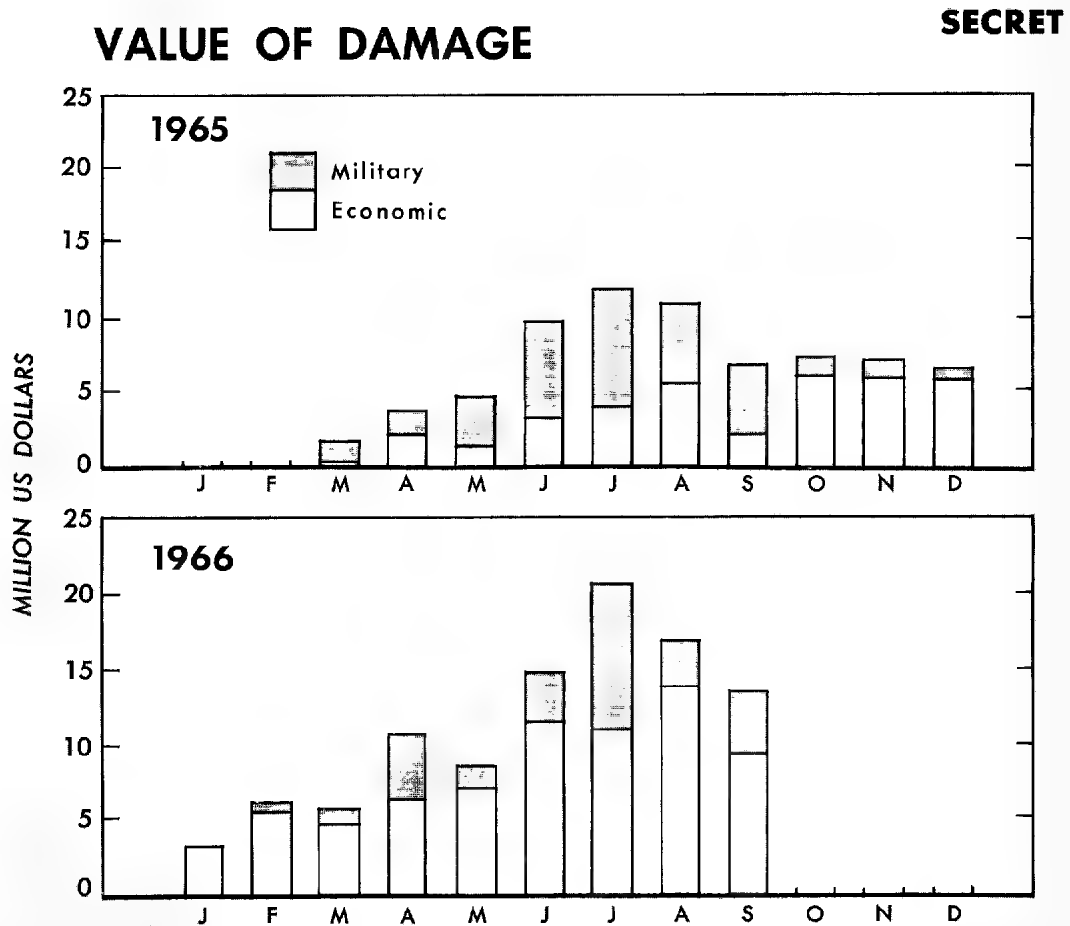


**1966**  
28.1



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Figure B-3. Value of Military Damage in North Vietnam, by Type, 1965 and January-September 1966



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Figure B-4. Value of Economic and Military Damage in North Vietnam, by Month, 1965 and January-September 1966

Table B1

Petroleum Storage Facilities Attacked Under the Rolling Thunder Program  
1965 and January-September 1966

JCS Target Number	Name	Target As a Percent of JCS Targeted Capacity	Dates of Attack	Percent of Facility Destroyed	Percent of JCS Targeted Total Capacity	Cost of Restoration (Thousand US \$)	Value of Petroleum Destroyed (Thousand US \$)
42.00	Phu Van	Negl.	6 May 65	100	Negl.	40	20
50.00	Vinh a/	6	2-, 26 May 65 11, 15 Sep 65 6 Oct 65	34 34 17	2 2 1	120 120 60	70 70 30
50.12	Nam Dinh	9	2, 4 Jul 65	100	9	500	270
50.16	Phu Qui	6	18 May 65	100	6	340	0
Subtotal for 1965					20	1,180	460
48.00	Haiphong	32	29 Jun 66 7 Jul 66 2 Aug 66	46 32 11	14 10 4	840 600 200	300 to 460 190 to 310 44 to 81
49.00	Hanoi	2-	29 Jun 66	100	24	1,380	490 to 760
50.00	Vinh b/		30 Jun 66 7, 8 Aug 66 6 Sep 66				
51.00	Nguyen Khe	6	30 Jun 66 19 Jul 66 17, 18, 22 Aug 66 4 Sep 66	10 0 0 0	Negl. 0 0 0	36 0 0 0	13 to 20 0 0 0
51.11	Bac Giang	2	30 Jun 66 31 Jul 66 11 Aug 66 14 Sep 66	31	Negl.	32	11 to 17
51.13	Do Son	2	29 Jun 66 3 Jul 66 5, 8, 10, 14, 15, 17, 22 Aug 66				
51.14	Viet Tri	1	30 Jun 66 19 Jul 66 14 Aug 66 5 Sep 66	0 3 0 0	0 Negl. Negl. Negl.	0 2 0 0	0 1 to 2 0 0
51.17	Duong Nhan	3	1, 12, 23 Jul 66 17, 22 Aug 66	25 50	1 2	46 94	16 to 25 24 to 50
Subtotal for 1966					56	3,294	1,105 to 1,760
Total					76 +	4,474	1,565 to 2,220

a. The facility at Vinh was attacked in August 1964, prior to the Rolling Thunder program.  
b. See the estimate for 1965.

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100 such sites, with a total estimated capacity of between 25,000 and 30,000 tons, had been identified.

Additional storage capacity is represented by the "55-gallon" drums dispersed throughout the country. It is estimated that by mid-1966 about 130,000 drums, representing a capacity of 22,000 tons, had arrived in North Vietnam. There have been 1,200 strikes against 400 dispersed petroleum storage sites, including either or both small tanks and drums, between April and October 1966. These strikes may have resulted in the loss of as much as 5,000 tons of storage capacity. The monetary value of these dispersed sites is small, however, and no attempt has been made to estimate the cost of their replacement.

## 2. Powerplants

Attacks on North Vietnam's facilities for producing electric power started in April 1965, and a total of eight powerplants have been struck. Three of the six plants attacked in 1965 were restruck in 1966, and two additional plants were attacked for the first time this year. The total number of strikes against each installation has ranged from 10 against Thanh Hoa to one against Viet Tri. During 1966, air operations against electric powerplants in North Vietnam were fairly evenly distributed throughout the country. Seven out of 13 strikes occurred in the northern part of the country, whereas during 1965 17 out of 21 strikes against powerplants took place in the southern part of North Vietnam. Total power-generating capacity in North Vietnam has been reduced by 32 percent. The total cost of restoration is estimated at \$11.9 million, of which \$5.6 million was accumulated during 1966 (see Table B2).

Some 12,000 kilowatts (kw) of previously undamaged operating generating capacity were destroyed during 1966. An additional 24,000 kw of new generating capacity, which were being installed at the Uong Bi powerplant but which were not yet in operation, were denied. Moreover, 24,000 kw of capacity temporarily damaged at the Uong Bi plant in 1965 and restored to operation during 1966 were again put out of operation, this time for at least a year. In terms of the loss of output, the attacks on powerplants have been more effective in 1966 than in 1965. About 47,000 kw of capacity were put out of operation in 1965, but only about 23,000 kw remained out of operation at the end of the year; in 1966 some 36,000 kw of operating capacity and an additional 24,000 kw of new capacity have already been denied to North Vietnam.

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Table B2

Electric Powerplants Attacked Under the Rolling Thunder Program  
1965 and January-September 1966

JCS Target Number	Name	Pre-Strike Target Capacity (kilowatts)	Target Capacity as a Percent of National Capacity <sup>a/</sup>	Dates of Attack	Percent of Target Capacity out of Operation <sup>b/</sup>	Percent of National Capacity out of Operation	Cost of Restoration Attributed to Each Strike (Million US \$) c/	Remarks
82.1	Thanh Hoa	5,000	3	4 Apr 65 27 Jul 65 29 Jul 65 30 Jul 65 31 Jul 65 4 Aug 65	100	3	0.2	Further damage in September 1966.
82.11	Ben Thuy	8,000	5	4 Jun 65 4 Jun 65	100	5	0.3 0.7	Additional strikes in 1966.
82.18	Co Dinh	1,500	1	8 Jun 65 10 Jun 65	100	1	0.2	No attempt to restore plant.
82.15	Nam Dinh	7,500	4	28 Jun 65 29 Jun 65 2 Aug 65 3 Aug 65	100	4	0.2 0.3 0.3 1.2	Progress of restoration during 1966 indicates possible partial operation around end 1966.
82.21	Ban Thach	1,000	0.5	21 Aug 65 22 Aug 65 23 Aug 65	100	0.5	0.1 0.2	No attempt to restore plant.
82	Uong Bi	24,000	14	15 Dec 65 20 Dec 65 22 Dec 65 22 Dec 65	100	14	1.5	Out of operation until March 1966.
Subtotal for 1965								
82	Uong Bi	24,000	13	18 Apr 66 28 Apr 66 11 Aug 66	100	13	6.3 0.1	Smokestack destroyed. Out of operation until July 1966. No additional damage. Severe damage to 24,000 kw operating plus an additional 24,000 kw being installed. No additional damage. No additional damage.
82.16	Thai Nguyen	24,000	13	14 Aug 66 17 Aug 66 6, 8 Jul 66	50	6	0.8	First strike. 12,000 kw of capacity out of operation.
82.17	Viet Tri	16,000	9	Prior to 19 Jul 66	0	0		First strike. Damage negligible.
82.11	Ben Thuy	8,000	4	13 Mar 66 15 Mar 66	100	4		Plant already out of operation. No additional damage.
82.1	Thanh Hoa	5,000	3	22 Sep 66 23 Sep 66 23 Sep 66 23 Sep 66	100	3	0.4	Restoration in progress but plant believed not operating. Probable minimum of 6 months for partial operation.
Subtotal for 1966								
Total								22 5.6 11.9

a. Based on national installed capacity of 175,000 kw in 1965 and on 187,000 kw in 1966.  
b. Information was not available on which to make a judgment until the final strike.  
c. Lack of an entry indicates either no damage or no information available on which to base an estimate.

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Although US airstrikes have put out of operation about one-third of the generating capacity in North Vietnam's electric power industry, the losses of power-generating capacity probably have had only a minor effect on the economy and on the ability of North Vietnam to conduct military operations. Remaining capacity has been adequate to supply most industrial consumers and probably even to supply minimal nonindustrial demands. There have been reports of occasional power shortages in Hanoi and Haiphong involving nonindustrial consumers, but no reports concerning restrictions on power supplied to industry. The major part of modern industry in North Vietnam is concentrated in and around these two cities. Shortages in the Hanoi-Haiphong area probably have made it necessary to discontinue service only to nonessential users during peak-load periods. The most severe shortages of power to industry are estimated to have occurred at Nam Dinh, Thanh Hoa, and Ben Thuy. Power supply to Nam Dinh probably has fluctuated during the past year, depending on whether the Uong Bi powerplant was in or out of service. Damage to powerplants in the vicinity of Thanh Hoa and Ben Thuy has virtually eliminated the supply in these areas for more than one year, but the effect on the national economy must have been slight in view of the small contribution to national product made by those localities.

The margin of reserve generating capacity available prior to the beginning of airstrikes apparently has been eliminated. Industrial demands probably could be generally fulfilled even if an additional 10 percent of generating capacity were lost. However, staggering work shifts and eliminating nonessential consumption by residential-commercial users, public lighting, and transportation probably would become necessary. Any additional losses of generating capacity would almost certainly reduce the power supply for industry.

The most important powerplants still operating in the Hanoi-Haiphong Power System are located at Thai Nguyen, Viet Tri, Hon Gai, and Bac Giang. Destruction of these plants would deny over one-half of remaining power-generating capacity. Hanoi would be forced to rely on a local powerplant which, in view of its age and generally poor condition, probably could supply no more than 40 to 50 percent of demand, and even this level of supply probably could not be sustained for long periods. Roughly the same deficit would occur in Haiphong which also would have to rely on two small, old powerplants that are in poor condition. Successful attack on the four important powerplants remaining would greatly reduce the power supply for heavy industry. The effects on light industry and agriculture

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would be less severe. The attacks would have little or no immediate effect on military capabilities, although they might have a minor effect in the long run.

North Vietnam has made some slow progress in restoring damaged power facilities. Repair work at Nam Dinh had progressed to a stage in August that indicates possible partial operation of this plant by the end of 1966. Restoration under way at the Thanh Hoa and Ben Thuy plants was either set back or nullified by airstrikes during September and October. There has been no attempt to repair the damaged powerplants at Co Dinh or at Ban Thach since mid-1965. The Uong Bi powerplant was put back into service after the strikes of December 1965 and April 1966, and work toward restoration apparently has been started again since the heavy destruction inflicted in August 1966.

The persistence of efforts to restore damaged power facilities underlines the importance of these plants to North Vietnam and strongly suggests that no suitable alternative to central generating plants has been found. Mobile generating units imported by the hundreds during the past 18 months apparently have failed to offset the loss of central generating facilities. From the sizes and total capacity of mobile units imported thus far, however, significant reliance on such units for industrial power supply is highly unlikely.

The history of the attack on powerplants during 1965 and 1966 indicates that they can be put out of operation for long periods of time only if the main buildings sustain direct hits; near-misses have produced a negligible effect. It is also clear that a number of restrikes were carried out against plants that already were out of operation. Finally, it seems probable that airstrikes against large powerplants in the main power system, such as Thai Nguyen, Viet Tri, Hon Gai, and Bac Giang -- had they been carried out -- would have produced far greater effect than the strikes actually made on the four small isolated powerplants in the area of Thanh Hoa and Ben Thuy.

### 3. Manufacturing

Only four manufacturing facilities of any significance have been attacked under the Rolling Thunder program, two in 1965 and two in 1966 (see Table B3). Although restoration costs are estimated to be comparatively small for damage to these plants in either year (\$1.2

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Table B3

Manufacturing Facilities Attacked  
Under the Rolling Thunder Program  
1965 and January-September 1966

JCS Target Number	Name	Target as a Percent of National Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of National Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
47.2	Lang Chi Explosives Plant	100	24 Jul 65 7, 8 Aug 65	71	71	370
	Nam Dinh Textile Mill	Cotton spinning: 70 to 75 Cotton weaving: 50	28 Jul 65	5	Spinning inactive: 60 Weaving inactive: 40	800
	Subtotal for 1965					<u>1,170</u>
	Cam Pha Coal Treat- ment Plant		19, 24 Apr 66			75
	Viet Tri Paper Mill	80	Mid-Jul 66	100	80	600
	Subtotal for 1966					<u>675</u>
	Total					<u>1,845</u>

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million in 1965 and \$700,000 in 1966), losses in production from these plants appear to be considerably more significant.

The two plants attacked in 1965 were the Lang Chi Explosives Plant (JCS No. 47.2) and the Nam Dinh Textile Plant, which is not targeted. Neither plant has been restored, and presumably greater imports are compensating for the loss in production from these plants. The Lang Chi plant is the only known explosives plant in North Vietnam. The Nam Dinh Textile Plant, although only slightly damaged unintentionally by a strike in late July 1965, is operating with only a small percent of its capacity, if at all. As a result, about 60 percent of the national spinning capacity and 40 percent of the weaving capacity have remained inactive for over a year. Inadequate or fluctuating electric power supply may be the major reason for this plant being inactive, rather than damage to the plant itself.

In 1966 the Cam Pha Coal Treatment Plant was attacked twice in April (as part of the attacks on the Cam Pha Port complex, JCS No. 68.0) and the Viet Tri Paper Mill (not targeted) was attacked in July. Damage at Cam Pha, although slight, resulted in a considerable reduction in coal exports, amounting to about \$3.7 million through September 1966. It is estimated that the major machinery at the Viet Tri Paper Mill was destroyed, and, if so, the plant will be inoperable for a long time. Work has begun to repair the roof of the plant. This plant represents 80 percent of the national capacity for paper production.

#### 4. Bridges

The total number of bridges confirmed by photography to have been damaged and destroyed by the Rolling Thunder attack in 1966 (January through September) was about equal to that obtained in 1965. The estimated cost of complete restoration and temporary repairs to the bridges also was about equal in the two years -- \$10.5 million in 1965 and \$9.7 million in 1966.

##### a. JCS-Targeted Bridges

Although the total number of bridges attacked in January through September 1966 was about equal to the number in 1965, attacks against JCS-targeted bridges decreased. In 1966, at least 133 strikes were carried out against 32 bridges, some of which had been attacked in 1965, compared with 144 strikes and restrikes against 47 JCS-targeted bridges in 1965. Almost all of the strikes

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against JCS bridges in 1966 were conducted under armed reconnaissance. As in 1965, most of the bridges struck were located in the southern part of the country. The number of strikes against highway bridges on the JCS target list decreased during 1966, whereas strikes against JCS bridges on the rail lines increased. Seventy-seven strikes were made against 31 highway bridges in 1965, compared with only 37 strikes against 16 bridges during the first nine months of 1966. On the railroads, 67 strikes were made against 16 bridges in 1965, compared with 96 strikes against 16 bridges during January-September 1966.

b. Armed Reconnaissance Bridge Targets

Aerial photography has confirmed the destruction or damage of 359 bridges since the start of the bombing, including those bridges on the JCS target list. About 150 of these bridges were struck initially since 1 January 1966. A total of 83 railroad, combination railroad/highway, and railroad bypass bridges have been confirmed as destroyed or damaged on all rail lines in the country. About one-half of these bridges were initially struck during January-September 1966, as shown in the following tabulation:

<u>Rail Line</u>	<u>Initially Struck During January-September 1966</u>	<u>Total Struck Throughout Bombing</u>
Hanoi - Dong Dang	2	5
Hanoi - Haiphong	0	2
Hanoi - Lao Cai	5	17
Hanoi - South	23	49
Spur and bypass	10	10
Total	<u>40</u>	<u>83</u>

In addition, aerial photography has confirmed the destruction or damage of almost 280 highway bridges, about 110 of which were struck initially in 1966.

Pilots have reported destroying or damaging about 1,900 bridges during January-September 1966, for a total of about 2,560 bridges throughout the bombing. These figures undoubtedly contain considerable double counting and overstatement of the damage inflicted. Excluding JCS-targeted bridges, a total of only 306 bridges

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are confirmed by photography to be destroyed or damaged. This figure probably understates somewhat the number of smaller bridges damaged or destroyed, however, because photography may not be available for some of these bridges. A comparison of the two sets of data is given in the following tabulation:

	<u>Destroyed or Damaged</u>	
	<u>Photographic Evidence</u>	<u>Pilot Reports</u>
Railroad and combinations	63	92
Highway	243	2,467
Total	<u>306</u>	<u>2,559</u>

#### 5. Railroad Yards

Many small railroad yards and sidings have been attacked by armed reconnaissance, and at least five comparatively important yards have been struck during the Rolling Thunder program. But the principal yards in the country, particularly those on the Hanoi-Haiphong and Hanoi-Dong Dang lines, have not been attacked. The yard at Thai Nguyen is the only relatively important yard attacked for the first time during 1966 (see Table B4). In addition, the yards at Vinh and Yen Bai were re-struck in 1966. The Vinh Classification Yard NW has been hardest hit by air attacks, with 75 percent of its capacity destroyed as of September 1966. This yard was struck at least three times in 1965 and six times in 1966. The Hanoi-Vinh rail line has been interdicted for through service during most of the time since the bombing began, however, and the yard generally has been used only in support of shuttle service.

The cost of restoration of the damaged rail yards amounted to \$400,000 in 1966, compared with only \$70,000 in 1965. Most of these costs stem from the need to repair railroad stations and other buildings, rather than yard track. The strikes have resulted in only temporary disruption to rail service during both years, and rail service at these yards has usually been restored within a few days.

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Table B4

Railroad Yards Attacked Under the Rolling Thunder Program  
1965 and January-September 1966

JCS Target Number	Name	Dates of Attack	Damage	Cost of Restoration (Thousand US \$)
21.1	Vinh Classification Yard N.W.	26, 27 May 65 1 Jun 65	Main line interdicted in four places; four sidings interdicted	70
	Nam Dinh Yard	2, 4 Aug 65	Damage to switching wye, rail sid- ings, tracks, and buildings	
	Yen Bai Yard	11, 13, 14 Jul 65	Damage to rolling stock; lines inter- dicted in numerous places	
	Subtotal for 1965			<u>70</u>
21.1	Vinh Classification Yard N.W.	18 Feb 66 4, 24 Apr 66 1, 22 May 66 9 Jul 66	75 percent of capacity destroyed as of September 1966	400
21.11	Thai Nguyen	29 Apr 66 5, 8, 22 May 66 10 Jun 66 2 Aug 66	20 percent of capacity destroyed as of September 1966	
	Yen Bai Yard	23 Apr 66	Cratered	
	Thanh Hoa Yard	12, 19 May 66 1, 23 Jun 66 22 Jul 66 18 Aug 66	Cratered	
	Subtotal for 1966			<u>400</u>
	Total			<u><u>470</u></u>

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## 6. Maritime Ports

Six North Vietnamese ports representing 88 percent of the country's total maritime cargo-handling capacity have been selected as JCS targets. Under the Rolling Thunder program for the first nine months of 1966, the port of Ben Thuy was restructed twice and Cam Pha port was attacked for the first time. Approximately 60 percent of the cargo-handling capacity at Ben Thuy was destroyed as a result of the attacks in 1965 and 1966 and approximately 20 percent at Cam Pha. In 1965 the only other JCS-targeted port attacked was Ham Rong, a minor port near Thanh Hoa. Damage to port facilities from 1966 strikes will cost about \$570,000 to restore, compared with about \$660,000 from 1965 strikes (see Table B5).

The impact of this damage in itself on North Vietnam's economy is not significant, but significant export losses have resulted. Ben Thuy represents only 4 percent of the nation's maritime cargo-handling capacity and Ham Rong only 1 percent. Both serve the southern provinces, which are largely rural. While Cam Pha is a major North Vietnamese port, representing 16 percent of the country's maritime cargo capacity, the \$160,000 damage against it is nominal. During the attack against it, however, the coal-washing machinery and the rail facilities were also hit. The damage to these facilities has already resulted in a coal export loss of about \$3.7 million.

Haiphong and Hon Gai, the two other most important ports, have not been subjected to attack. The Haiphong port complex represents 50 percent of the country's maritime port capacity and handles most of the import and export trade. Hon Gai, representing 16 percent of national cargo-handling capacity, handles primarily coal exports. These ports, representing 66 percent of the nation's cargo-handling capacity, are the only other significant deepwater ports in addition to Cam Pha in North Vietnam.

The cost of restoring the petroleum terminal at Haiphong -- damaged during the airstrikes against petroleum bulk storage -- is included in the cost of replacing the support facilities to the Haiphong petroleum installation (see 1, above).

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Table B5

Maritime Ports Attacked  
Under the Rolling Thunder Program  
1965 and January-September 1966

JCS Target Number	Name	Percent of National Maritime Cargo-Handling Capacity	Dates of Attack	Percent of Target Capacity Destroyed	Percent of National Cargo-Handling Capacity Destroyed	Cost of Restoration (Thousand US \$)
71.0	Ben Thuy	4	5, 6, 8 Jun 65 9, 10, 11, 17, 19, 21 Jul 65	61	2.4	470
71.13	Ham Rong	1	14, 16, 18 Jul 65	15	0.2	190
	Subtotal for 1965					<u>660</u>
71.0	Ben Thuy	4	1 Feb 66 8 Mar 66	61	2.4	470
68.0	Cam Pha Port	16	24 Apr 66	21	3.4	160
	Subtotal for 1966					<u>570</u>
	Total					<u>1,230</u>

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## 7. Locks

Only one attack was carried out against locks and dams in North Vietnam during 1966, and it was unsuccessful. Only two of the eight targeted locks on the inland waterways have been attacked. The Bich Phuong Lock No. 3, located in Thanh Hoa Province on the Song Chu Canal, was attacked in August 1965 and was heavily damaged. By 30 October 1965, temporary repairs had been made and the site of the lock had been coffer dammed. Water-level control was restored, and navigation continued, although it is interrupted at the site of the lock. Qua Nhue Ha Lock No. 2 on the same canal was attacked in 1966, but the lock continued to function after the attack.

Three of the targeted locks that have not been struck are located on the Song Thuong Canal, part of the inland water network that links Thai Nguyen with Hanoi and the seaport at Haiphong. Disruption of traffic on this waterway would create some transportation problems because a significant portion of the freight moved in the Delta region is transported by inland water. This waterway serves as an alternative to rail and road transport in the area, and thus the locks must be destroyed if disruption of transport routes in the Delta is to be achieved. The destruction of the four targeted locks that are still functioning in Thanh Hoa and Nghe An Provinces would present problems to canal traffic operating in the area. These canals have become significant routes for the transportation of supplies within Military Region IV.

## 8. Agriculture

Although agricultural production in North Vietnam has not been a direct target of the US/GVN airstrikes against that country, these attacks have had a significant indirect effect on the agricultural segment of the economy. It is impossible, however, to isolate the indirect effect of the bombings on agricultural production from other influences -- such as weather.

The bombing attacks have been associated with a decrease in agricultural production during the period 1965 through September 1966 which is valued at an estimated \$21 million. Of this amount, \$17 million is attributed to a shortfall of rice harvested during the spring of 1966. This shortfall was caused by poor weather and by the bombing attacks. A decrease in the salt water fish catch -- caused by the bombing attacks -- is responsible for the remaining estimated decrease in production. This decrease is valued at \$4 million.

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The shortfall in the 1966 spring rice crop was at least 200,000 tons below the 1961-65 average of about 1.7 million tons for spring rice.\* Since this crop was planted in late 1965, \$3.5 million of the loss was somewhat arbitrarily judged to have occurred in 1965 and \$13.5 million during the first six months of 1966.

While poor weather in the last half of 1965 and in the first half of 1966 undoubtedly contributed to the poor performance of agriculture, the disruptive effects of the bombing attacks were considerable. Even before the bombing attacks, agriculture in North Vietnam had experienced difficulties -- partly because of the unpredictable weather and partly because of management problems on agricultural cooperatives associated with the socialization of agriculture. The war has brought such additional problems as manpower shortages -- particularly skilled manpower -- the disruption of normal farming schedules, and the interruption of electrically powered irrigation systems and of the production and distribution of fertilizers. The efforts of the North Vietnamese to counter the disruptive effects of the bombing attacks -- including the importing of diesel generators to power the irrigation systems and of increased amounts of chemical fertilizers -- have not been completely successful.

The bombing attacks have resulted in serious interruption of fishing activities -- particularly offshore fishing -- in the three southern provinces of North Vietnam: Quang Binh, Ha Tinh, and Nghe An. It is estimated that this has been responsible for a loss in the salt water fish catch valued at \$4 million,\*\* with approximately \$1.7 million worth of this shortfall occurring in 1965 and \$2.3 million in 1966. The intensive fishing season in North Vietnam -- when most of the offshore fishing takes place -- is in the three-month period of September to

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\* There was no shortfall in rice production in 1965. Although the 1965 spring rice crop was above normal, the poor 1965 fall rice crop canceled out this surplus, giving about an average harvest. The spring rice crop normally makes up about one-third of the annual harvest and the fall crop most of the remainder.

\*\* Information on salt water fish catch in North Vietnam is limited. It is estimated that the three southern provinces are responsible for about one-third of the annual catch and that about one-third of this is caught offshore where most of the loss occurred. This suggests that the total salt water fish catch was down by about 10 percent. If the fish were valued at 1.50 dong per kilo -- a price that is between the wholesale and retail price of the various kinds of fish -- this loss would amount to \$4 million.

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November. Air attacks on fishing installations in these southern provinces appear to have been extensive, and some damage has been inflicted on these installations. The value of this damage, however, is believed to be minor.\*

The agricultural shortfall, the disruptive effects of the bombing attacks on agriculture and fishing activities, together with the increased requirements for the war, have contributed to food shortages -- particularly in rural areas. Food supplies in the larger cities such as Hanoi have been maintained at adequate levels, however, and there have been no indications of critical food shortages or cases of malnutrition. The continuation of the bombing attacks will further aggravate the tight food situation in North Vietnam. The self-sufficient nature of the agricultural economy and the availability of food imports -- particularly from Communist China -- suggest, however, that food supplies are not likely to become critical.

#### 9. Export Losses

From 1 April 1965 to 30 September 1966, measurable export losses attributed to direct and secondary effects of the Rolling Thunder program totaled \$12.9 million, of which \$4.2 million occurred in 1965 and \$8.7 million in 1966. Reduction in exports of apatite and coal accounted, respectively, for 61 percent and 28 percent of the total. Losses in seaborne exports of apatite resulted from repeated interdictions of the rail line connecting the apatite mines at Lao Cai with the port of Haiphong. Coal shipments were retarded by airstrikes against coal-processing facilities at Cam Pha in April 1966. Although production of cement is believed to have been unhindered, the remainder of the losses is accounted for by an apparent reduction\*\* in seaborne exports of cement since the initiation of the Rolling Thunder program.

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\* Out of seven sea product agencies -- local fish storage and processing units -- which allegedly have been bombed, only one has been identified in photographic intelligence. It is estimated that the replacement cost for damage inflicted on the sea product agency in Thach-kim village, Ha Tinh Province, is about \$60,000. Even if all of the other six sea product agencies had received similar damage -- available information indicates that this is not the case -- total damage would be less than one-half million dollars.

\*\* It is possible that undetected increases in exports of cement to China have been made on Chinese Communist ships.

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The decline is attributable in part, at least, to increased internal consumption of cement as a consequence of the bombing. The quarterly totals of these losses are presented in the tabulation below:

	Thousand US \$			
	<u>Apatite</u>	<u>Cement</u>	<u>Coal</u>	<u>Total</u>
1965				
2nd quarter	665	192		858
3rd quarter	1,043	324		1,367
4th quarter	1,554	395		1,949
Subtotal	<u>3,262</u>	<u>911</u>		<u>4,174</u>
1966				
1st quarter	1,554	205		1,759
2nd quarter	1,554	40	1,476	3,071
3rd quarter	1,457	244	2,192	3,893
Subtotal	<u>4,565</u>	<u>489</u>	<u>3,668</u>	<u>8,723</u>
Total	<u>7,827</u>	<u>1,400</u>	<u>3,668</u>	<u>12,897</u>

## B. Military

### 1. Barracks

Although about 35 strikes were made against at least 15 JCS-targeted barracks during January-September 1966, no significant additional loss resulted. All but one of the barracks had been struck in 1965, and more than half of them appeared to have been inactive at the end of 1965. The attacks in 1966 increased the percent of barracks capacity destroyed to about 23 percent of the total national capacity, compared with a little more than 18 percent destroyed at the end of 1965. The cost of restoration of the damage done in 1966 is estimated at about \$1.5 million, compared with about \$16 million in 1965 (see Table B6).

Before the beginning of the Rolling Thunder program, North Vietnam had barracks capacity for about 443,000 men. The 63 targeted barracks accounted for about 180,000 men. Thus far, about

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Table B6

Barracks Attacked Under the Rolling Thunder Program a/  
January-September 1966

JCS Target Number	Name	Percent of Targeted National Capacity	Dates of Attack	Percent of Targeted Capacity Destroyed		Cost of Restoration for Damage Inflicted During 1966 (Thousand US \$)
				During 65	As of 30 Sep 66	
28.00	Ban Xom Lom Barracks	2.3	18 Feb	57 (inactive)	57 (inactive)	0
26.00	Dien Bien Phu Barracks and Storage Area	2.3	19, 20, 21 Feb	52	87 (inactive)	800
39.3	Mu Gia Pass Barracks	0.1	1, 9, 10, 17 Feb	74 (inactive)	74 (inactive)	0
39.2	Vinh Linh Barracks Cent. NE	0.3	22 Mar 27 Apr	39 (inactive)	52 (inactive)	10
25.0	Son La Barracks Hq., MR North West	2.0	7, 8 Apr	52	61	190
39.34	Ha Tinh Barracks, Sup Dep.	0.2	9, 15 Mar 26 Apr 9, 10, 22 May 6 Jun	31 (inactive)	31 (inactive)	0
39.25	Vinh Son Barracks S	0.8	13, 14, 17 Apr	52 (inactive)	52 (inactive)	0
39.12	Dong Hoi Barracks Cit.	0.6	4 Apr	77 (inactive)	77 (inactive)	0
39.27	Vinh Barracks NNE	0.6	4 Apr	43	51 (inactive)	40
39.24	Sam Son Barracks W	0.3	12 May	22	56 (inactive)	100
39.46	Bien Son Barracks NNE	1.9	23 Jun 1, 5, 12 Jul	0	18	300
33.00	Dong Hoi Barracks WNW	1.1	N.A.	82	82 (inactive)	0
39.21	Yen Phu Barracks NE	1.0	20, 21 Aug	51 (inactive)	51 (inactive)	0
39.14	Badon Barracks	0.2	28 Aug 3, 12 Sep	30 (inactive)	99 (inactive)	100
39.18	Muong Sen Camp	0.1	31 Jan	100 (inactive)	100 (inactive)	0
Total						<u>1,540</u>

a. A few additional barracks have been attacked for which information is not available to estimate damage.

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45 of the targeted barracks have been attacked, with a loss of capacity for about 100,000 men. Other nontargeted barracks in outlying areas have been attacked by armed reconnaissance, but it is believed that the total capacity destroyed to date represents for the most part only excess or unused capacity. Most of the important barracks are located in the Hanoi-Haiphong complex and have not been attacked. The military strength in this area far exceeds that in outlying areas already struck. The order of battle strength of the North Vietnamese army is currently estimated at slightly over 300,000. Thus North Vietnam has sufficient capacity remaining to house the military forces.

The lack of barracks capacity in the areas where the destruction took place is, however, undoubtedly causing much inconvenience. Most of the barracks attacked are located in the southern part of the country, along the border of Laos, and in the northwestern provinces. These areas are particularly significant for infiltration of South Vietnam and military operations in Laos. Barracks in these areas have not been repaired. Apparently, troops are being quartered with civilians in nearby towns, in tents, and in other makeshift shelters in surrounding areas.

## 2. Airfields

Very little change has occurred in North Vietnam's airfield capability as a result of attacks on airfields during 1966 (see Table B7). North Vietnam has 23 airfields, of which 11 are targeted and considered to have economic and military significance. Four of the targeted fields were attacked in 1965, resulting in the destruction of about 20 percent of the total targeted airfield capacity. Although each of the bombed airfields had facilities left standing, the runways were heavily cratered and the fields were unable to receive air traffic. During the first nine months of 1966, there were only two strikes against Dien Bien Phu Airfield, one of the four attacked in 1965. The attacks took place in February with only slight additional damage to the runway, which had not been repaired. It is estimated that restoration of this additional damage would cost only about \$2,000, compared with a total of \$380,000 in restoration costs estimated for attacks on airfields during 1965. Recent observation of the Dien Bien Phu Airfield revealed that a portion of the runway is serviceable for light aircraft.

The damage inflicted on airfields thus has continued to have only limited secondary military and economic effects. Air transport and passenger service is virtually nonexistent in North Vietnam.

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Table B7

Airfields Attacked Under the Rolling Thunder Program  
1965 and January-September 1966

JCS Target Number	Name	Target as a Percent of National Targeted Capacity	Percent of Target Utility Destroyed	Dates of Attack	Percent of National Targeted Capacity Destroyed or Inactive	Cost of Restoration (Thousand US \$)
4.0	Dong Hoi	6	53 (inactive)	30 Mar 65 6 Jun 65 1 Jul 65 17, 22, 23 Sep 65	6	50
5.0	Vinh	6	10 (inactive)	8 May 65 30 Jun 65 1 Jul 65	6	43
1.0	Na San	4	45 (inactive)	25 Jun 65 23 Sep 65 24 Oct 65	4	144
2.0	Dien Bien Phu	3	94 (inactive)	2, 8 Jul 65	3	143
	Subtotal for 1965	<u>19</u>			<u>19</u>	<u>380</u>
2.0	Dien Bien Phu	<u>3</u>	94	6, 11 Feb 66	<u>3</u>	2
	Subtotal for 1966					<u>2</u>
	Total	<u>19</u>			<u>19</u>	<u>382</u>

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During 1966, North Vietnamese fighter aircraft have become more active outside of the sanctuary area surrounding Hanoi. The four airfields attacked during 1965 and 1966 do not have runways long enough to support jet fighters fully, and their vulnerable locations limit their usefulness as operating bases.

The three most important airfields in North Vietnam (Hanoi/Gia Lam, Haiphong/Cat Bi, and Phuc Yen) are located in the Hanoi-Haiphong area. These fields have full jet-handling capability and account for about 60 percent of the targeted capacity. The Kep airfield also has full jet-handling capability and accounts for an additional 10 percent of the capacity. At least three new airfields are under construction. These fields are located at Yen Bai, at Hoa Lac near Hanoi, and at Bai Thuong near Thanh Hoa. They will represent a significant addition to total airfield capability.

### 3. SAM Sites

From January through September 1966, 75 airstrikes were carried out against 60 SAM sites. The North Vietnamese are believed to be limited to about 25 SAM firing units (battalions), most of which have exhibited a high degree of mobility. Therefore, although 144 SAM sites had been identified as of 30 September, not more than 20 to 25 of them are believed to have been occupied at any one time.

Considerable damage was reported for the SAM facilities attacked, as indicated in the following tabulation:

	<u>Destroyed</u>	<u>Damaged</u>
Sites	25	25
Fan Song radars	19	
Missile transporters		3

Insufficient post-strike photography prevents making an accurate assessment of the amount of damage actually sustained by these SAM facilities in 1966. Damage reported by pilots could have totaled at

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least \$14 million\*; however, photography indicated only that equipment valued at some \$900,000 was destroyed.\*\* The actual amount of damage in 1966 probably lies closer to \$5 million.\*\*\* Damage to SAM facilities in 1965 was estimated at about \$630,000.

During this period, approximately 660 missiles (valued at about \$20 million†) were fired against Allied targets, resulting in the destruction of 22 planes and 14 drones.

#### 4. Naval Bases

By the end of September 1966, airstrikes against naval bases had destroyed almost one-fifth of the naval support facilities. The damage is estimated to have amounted to about \$1.2 million during 1965 and about \$400,000 during January-September 1966 (see Table B8).

Most of the increased destruction during 1966 resulted from restrikes on naval facilities at Quang Khe and Phuc Loi, two bases that had been hit during 1965. The only additional base attacked in 1966 was the Bai Chay Naval Complex located in the Hon Gai port area. One strike on this base in August resulted in the destruction of about 14 percent of its capability but represented only a relatively small cost of reconstruction. Possibly as another result of the strike, however, some of the command responsibilities for naval operations in the area have been shifted from the Bai Chay headquarters to the newly constructed command post at Binh Dong in the Haiphong area.

It is doubtful that the damage to the bases has seriously affected the operations of the small North Vietnamese navy. The major base accounting for 40 percent of the targeted capacity is located

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\* It is assumed that all of the sites reported destroyed were occupied when struck and that most of the major equipment was destroyed: specifically, the Fan Song radar, cabling, and an average of five launchers and three missiles. No attempt has been made to assign a value to the "damaged" category.

\*\* Two missiles on launchers, six launchers without missiles, and two sets of guidance and control equipment.

\*\*\* Cost computations are based on estimated production costs of replacement equipment; inasmuch as at least some of the equipment is believed to be older models not now in active service in the USSR, these computations probably overstate their true present value.

† This cost is not included in the estimated costs of physical damage resulting from the Rolling Thunder program.

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Table B8

Naval Bases Attacked Under the Rolling Thunder Program  
1965 and January-September 1966

Target Number	Name	Target as a Percent of National Naval Base Support Capacity	Dates of Attack <sup>a/</sup>	Percent of Base Utility Destroyed	Percent of National Naval Base Support Capacity Destroyed	Cost of Restoration (Thousand US \$)
74.1	Quang Khe Naval Base	15	2 Mar 65 28 May 65 21, 24, 27, 28 Sep	47	7	400
71.1	Phuc Loi	10	20 May 65 12 Sep 65	78	8	815
	Subtotal for 1965				<u>15</u>	<u>1,215</u>
74.1	Quang Khe Naval Base	15	26 Apr 66	47	7	100
71.1	Phuc Loi	10	4, 5 Apr 66	78 (inactive)	10	230
69.0	Bai Chay	17	6 Aug 66	14	2	28
	Subtotal for 1966				<u>19</u>	<u>358</u>
	Total				<u>19</u>	<u>1,573</u>

a. Dates of attack indicate only assigned strikes; in certain instances more attacks have been launched against a specific target than is indicated above.

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in the Haiphong port area and has not been attacked. The other targeted base not yet struck is Port Wallet, located about halfway between Hon Gai and the Chinese border. In addition to these five targeted bases, North Vietnam has naval support facilities in ten other ports. Restoration of the damaged bases can be accomplished quickly and with local materials, with the exception of replacing or repairing machinery that may have been destroyed or damaged.

### 5. Radar

North Vietnam has 50 known radar sites, of which five coastal sites were targeted because of their strategic location. During 1965-66, these five targeted sites were attacked. Two sites (Hon Matt and Hon Nieu) were totally destroyed and two (Vinh Son and Bach Long) were damaged. The extent of damage to the remaining site (My Duc) is unknown. Damage or destruction of targeted sites amounted to an estimated \$1.7 million during 1965 and to slightly over \$900,000 in 1966 for a total of \$2.6 million. Details of the types of radar damaged or destroyed and their estimated value are shown in the following tabulation:

Site	Radar Model	Total Value (Thousand US \$)	Destroyed or Damaged (Thousand US \$)
1965			
Vinh Son	1 Track Dish - fire control	245	245
	2 SCR-270 - early warning	270	270
	3 Firecan - fire control	1,000	
	1 Cross Slot - early warning	135	645
	1 Spoonrest A - early warning	135	
Bach Long	1 Cross Slot - early warning	135	135
Hon Matt	2 Cross Slot - early warning	270	270
Hon Nieu	1 Cross Slot - early warning	135	135
My Duc	1 Cross Slot - early warning	135	N.A.
	1 Rus-2 - early warning	135	N.A.
	1 SCR-270 - early warning	135	N.A.
	Subtotal for 1965		<u>1,700</u>
1966			
Vinh Son	1 Spoonrest A - early warning	135	135
	1 Firecan - fire control	335	335
	2 Firecan - fire control	670	
	1 SCR-270 - early warning	135	374
	1 Cross Slot - early warning	135	
Bach Long	1 Cross Slot - early warning	135	80
Hon Matt	None		
Hon Nieu	None		
	Subtotal for 1966		<u>924</u>
	Total 1965 and 1966		<u>2,624</u>

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Except for the radar destroyed at the Hon Matt and Hon Nieu sites in 1965, radar at the three remaining targeted sites have been repaired or replaced as necessary, thus permitting the sites to continue operations. Air defense coverage for the Hon Matt and Hon Nieu area is provided by radar located at Vinh Lin and Hong Doi.

The overall air warning capability of North Vietnam has not been affected by bombing of targeted radar sites during 1965-66. During the period of the Rolling Thunder program, the number of radar deployed at sites throughout North Vietnam has increased.

#### 6. Communications

North Vietnam has at least 35 major high-frequency (HF) radio centers and several hundred small HF radio stations. Five of the centers are JCS targets, only two of which have been struck, both in 1965. These two facilities, the Chanh Hoa and Muong Sen radio centers (JCS Nos. 67.3 and 39.19), represent 20 percent of the targeted capacity [REDACTED]. In addition, a nontargeted center at Quang Khe was destroyed in 1965, and the center at Dien Bien Phu, although not bombed, was dismantled. The other JCS targets are located in the Hanoi area, and a fair number of the nontargeted centers are also located in that area. Those centers attacked or dismantled in 1965 were all located some distance south or west of Hanoi. Restoration of the damage inflicted on HF radio centers in 1965 is estimated at about \$75,000.

The full extent of physical damage to the wireline system of North Vietnam cannot be estimated. The wireline system has not been specifically targeted for destruction and the damage sustained has been a collateral effect of the bombing of rail and road facilities, which are generally paralleled by open wirelines. [REDACTED]

[REDACTED]

[REDACTED] There is a strong possibility that wireline damage has been extensive but it is not being picked up by intelligence collection media. Cumulative monetary damage to the open wireline system since the beginning of Rolling Thunder is estimated very roughly at \$100,000, of which \$80,000 probably occurred during 1966.

Although the cost of the damage inflicted on communications is nominal, indirect costs in this field resulting from the Rolling

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Thunder program appear to be substantial. Damage inflicted on other sectors of the economy in North Vietnam has produced a considerable increase in domestic communications requirements. The establishment and expansion of new communications networks have become an especially urgent need for units assigned to the repair, maintenance, and augmentation of transportation and logistics facilities. In order to service these new requirements, North Vietnam has been forced to seek sizable quantities of communications equipment from foreign suppliers and to construct new telecommunications transmission media. In the spring of 1966, North Vietnam imported one hundred 15-watt radiotransceivers and ten 1-kilowatt transmitters at an estimated cost of \$270,000. Currently, Hanoi is attempting to procure 30,000 kilometers of military field wire at a cost that could exceed \$1 million if purchased in the West. Additional telecommunications equipment in smaller quantities -- including tele-typewriters, radiobroadcast receivers, and multiplexing gear for the open wireline system -- also has been imported. Since at least February 1966, photography has identified construction activity on at least six new open wireline routes in North Vietnam. Although it is impossible to distinguish precisely between communications requirements induced as a direct result of bomb damage and those generated by the expansion of North Vietnam's military establishment, it is clear that the Rolling Thunder program has been an important, if not the prime, force in increasing the complexity of Hanoi's communications problems. On balance, however, it appears that the operational efficiency of the telecommunications system of North Vietnam has not been seriously impaired, and if the present trend continues, North Vietnam will have significantly increased telecommunications capacity.

#### 7. Supply and Ordnance Depots

Ten of the 17 targeted supply depots have been attacked under the Rolling Thunder program. Restrikes on a few depots in 1966 resulted in insignificant damage and only slight additional loss of national capacity. Restoration of damage inflicted in 1966 will cost about \$130,000, and that in 1965 will cost at least \$3 million.

North Vietnam had a total storage capacity at all known installations of about 10.6 million square feet before the beginning of the Rolling Thunder program. The total storage capacity of the 17 targeted installations is about 3.4 million square feet. Destruction of targeted installations represents about 15 percent of the national capacity. Most of the destroyed installations are located in the southern

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provinces and along the Laotian border. Except for the Vinh Supply Depot (serving Military Region IV) and the Yen Bai Ordnance Depot (serving the area northwest of Hanoi), the depots struck are of relatively minor importance to the North Vietnamese army. The largest supply depots, located in the Hanoi area and at Thai Nguyen, have not been attacked.

#### 8. Ammunition Depots

Information available indicates that airstrikes have been carried out against only two JCS-targeted ammunition depots so far in 1966 -- the Xom Bang (JCS No. 64.00) and Xom Rung (JCS No. 47.18) depots, both of which had been attacked in 1965 and were inactive at the end of the year. The attacks in 1966 resulted in slight additional damage, the restoration of which will cost only about \$200,000. Attacks in 1965 against 13 depots resulted in damage amounting to about \$4.5 million.

North Vietnam had storage capacity for about 112,600 tons of ammunition at the beginning of 1965, exclusive of storage in barracks and headquarters complexes. It is believed that attacks carried out through September 1966 have destroyed about one-fourth of this capacity. There is no indication that the depots resumed activity after being attacked.

The destruction of the depots probably has caused temporary delays in distribution and inconvenience but has not caused shortages of ammunition in the areas where they are located. Four of the depots destroyed are located north or northwest of Hanoi and could have been used for the receipt of ammunition from Yunnan Province in China. The other depots are important for regional support of the North Vietnamese troops and for supplying the Communist forces in Laos and South Vietnam. Other depots not yet attacked, located in the Hanoi-Haiphong area, are much more significant in the system for importing ammunition from China, distributing it internally, and arranging for its infiltration into neighboring countries.

#### 9. Naval Craft

A total of 10 North Vietnamese naval craft have been destroyed by US aircraft through September 1966. In 1965, three Swatow-class gunboats were sunk while in waters near Haiphong and Hon Gai, and a fourth was destroyed while in tow at sea. In 1966,

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three PT boats were sunk while at sea, and two SO-1 subchasers and one Swatow-class gunboat were destroyed while moored near Cac Ba Island.

According to the North Vietnamese Naval Order of Battle as of 15 September 1966, the loss of the five Swatow-class gunboats has deprived North Vietnam of almost one-third of the operational gunboat fleet; the loss of the three PT boats leaves North Vietnam with only nine operational craft of this type, and there are now only two subchasers operational.

The estimated restoration cost of these naval craft totals \$8.1 million. The loss incurred during 1966 accounts for \$6.1 million.

#### 10. Aircraft

North Vietnamese aircraft losses increased significantly during the first nine months of 1966 as a consequence of air engagements with US aircraft. Three supersonic MIG-21's and 14 MIG-17's were destroyed, compared with only five MIG-17's in 1965. These cumulative losses represent nearly 20 percent of the MIG-21 inventory (16) and more than 40 percent of the in-country MIG-15/17 inventory (45) in the Air Order of Battle of North Vietnam as of 3 November 1966. An additional 50 MIG-15/17's of the North Vietnamese are known to be held in China.

Almost all of the MIG's were destroyed during strikes against fixed targets. The destruction in 1965 occurred in June and July. In 1966, MIG losses were greatest in April, with five, June, with four, and July and September, with three each. The estimated cost of this loss is \$3.4 million in 1965 and \$12.4 million in 1966.

#### C. Armed Reconnaissance

During 1966, Rolling Thunder became almost exclusively an armed reconnaissance program directed primarily against the North Vietnamese lines of communication and transport targets. The effect of the attack on lines of communication and other fixed targets was discussed in an earlier section of this appendix. The armed reconnaissance attack on the logistics target system is discussed in detail in Appendix E.

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1. Transport Equipment

Destruction and damage of all types of transport equipment by airstrikes increased considerably during the first nine months of 1966 compared with 1965. The following tabulation, which is based primarily on pilot reports and includes some duplication and exaggeration,\* provides a general indication of the increase in damage inflicted, by type of equipment.

<u>Type of Equipment</u>	<u>1965</u>		<u>January-September 1966</u>	
	<u>Destroyed</u>	<u>Damaged</u>	<u>Destroyed</u>	<u>Damaged</u>
Locomotives	6	6	10	13
Railroad freight cars	227	592	1,061	850
Trucks	318	487	1,617	1,479
Ferries	53	56	64	118
Barges	263	487	1,813	2,977
Other water craft	144	210	816	1,255
Total	<u>1,011</u>	<u>1,838</u>	<u>5,381</u>	<u>6,692</u>

The estimated cost to the North Vietnamese of destroyed and damaged transport equipment increased from \$5.9 million in 1965 to \$24.5 million in 1966.

In spite of the significantly higher level of damage inflicted during 1966, there has been no evidence of serious transport problems resulting from shortages of equipment. Imports of locomotives and trucks have been sufficient to maintain inventories at the 1965 level. Reported losses of freight cars have included a significant number of small, makeshift cars used on the rail lines south of Hanoi which have not been included in the inventory of mainline freight cars. Although this mainline inventory has decreased by about 35 percent during 1966, there has been no indications of serious shortages of freight cars. If a high rate of utilization is assumed for the remaining freight cars, the September 1966 inventory is sufficient to handle the decreased volume of rail freight carried. Furthermore, Communist China probably has loaned or given North Vietnam all the freight cars needed to compensate for any shortages. Although some watercraft and motors for water craft have been imported, most of the watercraft needed to compensate for losses apparently have been constructed domestically. Sightings of watercraft indicate that there has

\* The data have been adjusted downward to eliminate duplication whenever possible.

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been no significant decrease in the number of watercraft in use during 1966 in spite of the considerable increase in the level of destruction.

## 2. Miscellaneous Targets of Armed Reconnaissance

During 1966 the number of sorties flown under the armed reconnaissance phase of the Rolling Thunder program increased to about three times the number flown in 1965. Armed reconnaissance sorties accounted for more than 99 percent of the total attack sorties flown in 1966, compared with about 75 percent of those flown in 1965. Most of the damage resulting from this program has been discussed under the major categories of targets. Pilot and bomb-damage assessment reports, however, have revealed a variety of miscellaneous targets which have been destroyed or damaged and which were not included in the major categories. These miscellaneous targets consist mainly of transport and military facilities. The inventory of these facilities as reported by pilots is given in Table B9. The number of such targets reported as destroyed or damaged in 1966 increased significantly over the 1965 level, especially in the case of transport facilities.

Because of the nature of air operations, it is difficult for pilots to provide a definitive evaluation of destruction or damage to targets. There is also some double counting in reporting. There is a tendency to overstate the amount of destruction or damage, but there is no rational basis currently available for deflating reports properly. In providing estimates of replacement cost, there is the further problem that the description of each target or target category is not precise. Costs can be based only on the destruction or an assumed level of damage to a typical target in each category. With these limitations in mind, the restoration costs of these miscellaneous targets have been computed. The cost of restoring or repairing the miscellaneous transport facilities attacked in 1966 is roughly estimated at about \$1.1 million and the military facilities at about \$1.4 million. Damage to all such miscellaneous targets in 1965 was estimated at about \$700,000.

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Table B9

Inventory of Miscellaneous Damage  
by Armed Reconnaissance Sorties a/  
1965 and January-September 1966

	<u>Destroyed</u>		<u>Damaged</u>	
	<u>1965</u>	<u>1966</u>	<u>1965</u>	<u>1966</u>
Transport facilities <u>a/</u>	<u>0</u>	<u>149</u>	<u>75</u>	<u>5,887</u>
Piers		12		25
Road segments				2,670
Ferry facilities		15	75	262
Bridge approaches		7		1,558
Fords/ford approaches		29		308
Bridge bypasses		13		190
Causeways		17		182
Railroad yards		9		19
Railroad segments		2		660
Road construction equipment		28		8
Bulldozers		13		5
Cranes		2		
Road graders		2		
Military facilities	<u>1,911</u>	<u>3,582</u>	<u>2,625</u>	<u>2,303</u>
Barracks	93	48	137	32
Supply warehouses	71	73	105	65
Structures/buildings	1,673	2,920	2,024	1,720
Antiaircraft sites	62	316	88	252
Automatic weapons sites		164		75
Radar and communications sites	9	29	133	49
POL storage areas		12		17
POL tanks		15		6
Truck parks	3	5	138	87

a. Some of the differences in numbers of transport items reported in the two years reflect changes in reporting methods.

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## II. Civilian and Military Casualties

The cumulative civilian and military casualties attributable to the Rolling Thunder program through September 1966 total 28,900, of which an estimated 17,900 are civilian personnel. Some 13,200 of the total casualties occurred in 1965. On the basis of sample data through the first nine months of 1966, North Vietnamese civilian and military casualties are estimated to have been about 40 percent killed and 60 percent wounded.

During 1966 the emphasis on armed reconnaissance rather than attacks on fixed targets resulted in armed reconnaissance accounting for 93 percent of total casualties, compared with 52 percent in 1965. The swing away from attacks on JCS-designated fixed targets had several notable results in terms of human casualties in North Vietnam. In 1965 a greater emphasis in attacks on fixed targets, which are predominantly military, resulted in military personnel accounting for almost 55 percent of total casualties. In 1966, however, military personnel accounted for only about 24 percent of total casualties.

The preponderance of civilian casualties resulting from the acceleration of armed reconnaissance has in large measure involved those civilians who are most directly engaged in the maintenance and operation of the logistics system moving supplies and personnel into Laos and South Vietnam. The total impact of some 11,900 civilian casualties, including possibly as many as 5,000 deaths, is not an inordinately high result from military action against North Vietnam. The impact of this loss is even smaller when compared with the annual total in North Vietnam of some 350,000 natural deaths, and the annual number of accidental deaths which is from two to three times the deaths resulting from the Rolling Thunder program.

### A. Casualties from Attacks on Fixed Targets

In the past year the Rolling Thunder attack against JCS fixed targets has changed considerably in both size and scope. Some 2,000 attack sorties were directed against JCS targets in 1966, compared with 8,700 sorties flown in 1965. The JCS strikes in 1965, generally were directed against facilities in areas with relatively low population densities. During 1966 the growing scarcity of unstruck JCS targets has resulted in a restrained bombing program against more lucrative targets in areas having much higher population densities

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(in Hanoi and Haiphong) in addition to restrikes against those facilities hit in 1965.

It is estimated that at a minimum some 700 civilian and 400 military casualties resulted from attacks on fixed targets in 1966. In an absolute sense, this compares favorably with the 2,000 civilian and 4,300 military casualties estimated to be inflicted by the 1965 JCS target campaign. The 1966 casualties, however, are at a rate of 0.6 per attack sortie, compared with a rate of 0.7 per attack sortie in 1965. The decrease in the sortie-casualty ratio undoubtedly reflects the considerable care given to the selection and direction of attacks against the new target system put under attack in 1966.

This estimate of casualties resulting from attacks on fixed targets is based essentially on methodologies formulated by DIA. The DIA estimate has been weighted, however, to take into account the data on casualties reported in prisoner-of-war reports [REDACTED]

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[REDACTED] The investigation of these [REDACTED] sources showed that initial attacks on JCS fixed targets have inflicted casualties that are nearly four times greater than the minimum DIA post-strike estimates of casualties. Consequently, the minimum DIA casualty estimates for attacks against previously unstruck JCS targets hit in 1966 were weighted by a factor of four. Facilities hit in both years were credited with the minimal estimate for purposes of estimating the 1966 casualty figure. This was done to take account of the probability that inhabitants residing in areas previously attacked would either move out or construct adequate shelter. The number of casualties derived by this method are shown in the following tabulation:

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<u>JCS Fixed Target System</u>	<u>Number of Casualties</u>		
	<u>Military</u>	<u>Civilian</u>	<u>Total</u>
Barracks/supply depots/ ammunition depots	300	50	350
POL storage	50	100	150
Powerplants		80	80
Airfields	20		20
Bridges		180	180
Rail yards		200	200
Ports	30	90	120
Total	<u>400</u>	<u>700</u>	<u>1,100</u>

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**B. Casualties from Armed Reconnaissance Missions****1. General**

During 1966 the armed reconnaissance program over North Vietnam accelerated sharply. Some 57,500 armed reconnaissance attack sorties were flown through September 1966, against non-fixed targets compared with 25,300 in 1965. The armed reconnaissance program has been gradually expanded to cover nearly all of North Vietnam. The program remains, however, one with the limited goals of minimizing civilian casualties and maximizing damage to the infiltration-transportation network.

It is estimated that some 10,000 civilian and 3,400 military casualties were inflicted on North Vietnam as a consequence of the armed reconnaissance program in 1966. This represents a considerable increase over the estimated 4,000 civilian and 2,900 military casualties in 1965. The rate of casualties per sortie has remained stable, however. In 1966 casualties were inflicted at the rate of 0.23 per sortie, compared with 0.27 in 1965. The stability of this ratio undoubtedly reflects improved North Vietnamese air warning and civilian defense measures and the continued efforts by the USAF and USN to minimize casualties as the tempo of the airwar increases.

**2. Armed Reconnaissance on Pre-briefed  
Non-JCS Targets**

In the past year it is estimated that some 1,200 additional casualties were inflicted on the North Vietnamese civilian population as a consequence of the armed reconnaissance attacks against small pre-briefed non-JCS targets. These facilities were for the most part targets of secondary importance but were attacked as fixed targets. Casualty estimates were made on the same basis as that used for attacks on JCS fixed targets. Because no estimate of this type exists for 1965, it is impossible to put the current casualty estimate in perspective. A tabulation of the targets and the respective casualties is presented in the following tabulation:

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<u>Target</u>	<u>Number of Casualties</u>
Ports	30
POL	180
Storage areas	800
Rail yards	100
Bridges	90
Total	<u>1,200</u>

### 3. Methodology

#### a. Civilian Casualties

Three factors were employed to estimate civilian casualties inflicted by the armed reconnaissance program in 1966. A daily casualty factor was derived [REDACTED] for a representative Route Package.\* This factor was then expanded to cover all of the six Route Packages in North Vietnam. Modifying indexes were calculated to reflect the varying population densities and sorties flown in the respective Route Packages in 1966. The adjusted daily casualty figures for each Route Package were then multiplied by the number of days of air operation in the specific Route Package.

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\* For an explanation of the term Route Package, see Figure A7.

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Average daily casualties for the 30-day period were 2.2 killed by air and 6.7 wounded by air. Because [redacted] prisoner-of-war reports, and [redacted] reflected sporadic references to the bombing of schools and hospitals, a factor for these inadvertent attacks was also included in the daily casualty figures. The final daily casualty rates for civilians as a consequence of the armed reconnaissance were estimated to be 3.5 killed and 8.0 wounded in Route Package II.

b. Military Casualties

The problems encountered in deriving a credible estimate of military casualties inflicted by armed reconnaissance were insoluble. [redacted]

[redacted] Prisoner-of-war reports and Thai letters were also of marginal value. A methodology employing the results of the armed reconnaissance program weighted the number of trucks or other facilities destroyed and damaged with DIA estimates of casualties per truck and per other facility in the following tabulation:

	<u>Number Destroyed or Damaged</u>	<u>Weight</u>	<u>Military Casualties</u>
Barracks	80	0.1	10
Supply warehouses	138	0.1	10
Misc. buildings	4,640	0.1	460
Radar Com.	78	0.1	10
Truck parks	92	0.1	10
AAA sites	568	0.1	60
Trucks	3,096	0.5	1,550
Watercraft	2,071	0.5	1,040
RR cars	2,234	0.1	220
Total			<u>3,400 a/</u>

a. Because of rounding, components may not add to the total shown.

In two specific categories, trucks and watercraft, the casualty weights were decreased to reflect the information gained from prisoner-of-war reports [redacted] It should be pointed out, however, that at best this method represents a very crude approximation of military casualties.

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## APPENDIX C

SELECTED THIRD COUNTRY ATTITUDES  
TOWARD THE BOMBING OF NORTH VIETNAM

There has been a wide variety of popular and official reactions in the Free World to the bombing of North Vietnam. A study of selected Free World countries indicates, on the one hand, that there is considerable support for the US action. Most important in producing this support has been the fear of further Communist aggression should the United States fail in its defense of South Vietnam. There also appears to be more popular and official backing in countries which are partially or wholly dependent on the United States for economic and/or military assistance.

There is very strong popular opposition to US policy on Vietnam, including the bombing of the north, in some of the major neutral nations and countries allied with the United States. This opposition, which stems primarily from fear that the war will escalate into a worldwide conflict, or from the view that the United States is guilty of "aggression" against a weaker, Asian state, has definitely limited official support for US policy in some countries. In a few instances, there has been a definite growth in popular opposition as the US air war escalated. In most cases, however, popular and official attitudes have remained relatively static since the start of the sustained air attacks, or else the opposition to the raids has tended to moderate.

The moderation has resulted from several factors. For one thing, the populace in some countries has tended to become inured to the war and has lost interest in the actions of both sides. There has also been a demonstrable return from the indications of US willingness to end the bombing if the other side will take reciprocal de-escalatory action. The intransigence of the Vietnamese Communists in the face of US bombing pauses has definitely cost them some Free World support.

A major escalation of the air war in the future, especially if accompanied by substantial civilian casualties, is likely to produce a significant intensification of opposition to the bombing in some countries. Stronger denunciations of the United States, independent action in the United Nations, and other political protest activities might be forthcoming. It is unlikely, however, that any Free World country

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will take retaliatory action in its bilateral relations with the United States or that any Free World country will change its policy to the point of offering significantly greater political or material support to the Vietnamese Communists.

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# I. The Far East

There is considerable popular and official support in the Far East for US policy in Vietnam. The majority of government leaders are fearful of Chinese Communist aggression and are convinced that US defense of South Vietnam is essential to preserve freedom in the area. In general, support for US policy extends to approval or acquiescence in the US bombing of North Vietnam. Since the inception of the raids, there have been only minor changes in official and popular attitudes in the Far East toward the air attacks. Those that disapproved, remain opposed; those who approved, still do, although in some cases more reluctantly than before. Among the countries that generally support the United States on the air attacks are Australia, Malaya, New Zealand, Japan, Thailand, South Korea, and Taiwan.

In some of the countries which officially oppose the attacks, there is an underlying ambivalence in attitudes on the war that has tended to dampen active opposition to the raids. This can be seen, for example, in Indonesia where there is a deep distrust of policies identified with imperialism, but also a strong anti-Communist and anti-Chinese sentiment. Some Indonesian military officers and some key civilian leaders have quietly let the United States know that Djakarta understands and supports the US position but is likely to hedge its public statements because of strong popular opposition. There is widespread sympathy for Hanoi in its fight to gain "independence" of the West.

Significant opposition in the Far East to the US air attacks has also come from Cambodia and, to a lesser extent, from Burma, where there is official understanding of the US position, but considerable popular disapproval.

It is clear that the persistent indications of US willingness to end the air raids if the Vietnamese Communists take reciprocal action have helped maintain popular and official support for the United States throughout much of the Far East. Overall support in the Far East has, in fact, increased in the wake of the US peace efforts made since late 1965. This change can be readily seen in Japan, where the development of popular and official attitudes on the air raids has been fairly typical of independent Asian opinion.

The Japanese Government has approved of American efforts to hold the line in Southeast Asia since the initial US involvement in the Vietnam war. However, negative attitudes on the war among the

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Japanese people have compelled Tokyo to refrain from professing unqualified support for Washington. In public, Japanese leaders have tended to explain their support in terms of the US-Japan security relationship rather than in terms of Japan's own national interest. The Japanese press, the socialists, and labor have been highly critical of US policy and have attempted to marshal public opinion against the air attacks. There was some fear among the Japanese public, even prior to the beginning of the sustained bombings in late February 1965, that the escalation of hostilities might involve Japan.

The Japanese Foreign Minister told the Diet on 10 August 1964 that the government believed the Tonkin Gulf crisis had been initiated by the North Vietnamese. However, a large segment of the public apparently felt that the United States had over-reacted against its tiny adversary and was uneasy about the possibility of a larger conflict.

The Japanese Government supported the program of sustained US airstrikes in North Vietnam which began early in 1965, but its leaders were clearly uncomfortable over their policy. During Diet interpellations on 8 February, Prime Minister Sato stated that he considered the airstrikes limited in scope and hoped the war would not be expanded. Japanese press and radio reactions were generally negative.

Sato continued to cautiously support US policies in Vietnam following the renewal of the airstrikes after the May 1965 pauses. However, many of his party members privately expressed strong reservations about the effectiveness of the strikes. By early summer, criticism of US Vietnam policies was very widespread and acerbic. The B-52 strike by Okinawa-based planes on 28 July sharpened fears that Japan would become involved in the war as a result of its defense ties with the United States.

The situation began to change somewhat during the last few months of 1965. There was a slow but steady improvement of Japanese public attitudes toward the US involvement in Vietnam during the autumn, partly as a result of US efforts to publicize its objectives in Vietnam. The December-January pause in the bombing produced an even sharper shift of popular opinion in favor of the United States. Japanese officials were sympathetic to the resumption of the airstrikes, which they felt had been prompted by the Communists' failure to respond to US peace initiatives. The restrained manner in which the bombing was resumed together with the continued American diplomatic offensive for negotiations tended to counter adverse reactions. During 1966,

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Japanese popular attitudes toward US policy in Vietnam remained greatly improved, compared with early 1965. Fears that the war might expand into a major US-China conflict seemed to have subsided somewhat as confidence in US restraint and moderation increased.

Japanese officials publicly minimized the prospect that the US bombing of the petroleum installations near Haiphong and Hanoi would result in a general expansion of US military action in Vietnam. Prime Minister Sato stated his belief that the raids had been limited to military targets and that the United States would not deviate from this policy. Popular protests over the POL attacks came almost entirely from leftist groups. The modest impact of the Hanoi-Haiphong strikes on the general public was apparently attributable to popular boredom with the war. Press comment was more regretful than condemnatory in tone and reiterated hopes for a negotiated settlement.

The reaction in Japan and the situation in other Far Eastern countries suggest that a continued gradual escalation of the air war in North Vietnam, so long as it involves primarily military or related economic targets and does not result in demonstrably high civilian casualties, will probably not cause a significant change in current official and popular attitudes in the Far East.

A representative selection of popular opinion on US policy in Vietnam in major cities of the Far East in July 1965 is given in the following tabulation:

City	Percent		
	Approve	Disapprove	No Opinion or Unaware
Manila	49	3	48
Seoul	47	4	49
Bangkok	45	8	47
Kuala Lumpur	19	12	69
Singapore	10	6	84
Tokyo	6	38	56

This sampling probably represents the high point of the opposition to the raids since, as indicated above, there has been some moderation in opinion during 1966.\* These questions were asked: "Do you approve

\* No representative sampling of popular opinion specifically on the raids against North Vietnam is available. The sampling above was obtained by USIA and is taken from its publication US Standing in World-wide Public Opinion, 1965. A similar sampling for 1966 is not available.

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